MODERN PLASTICS

JANUARY 1945

HOW TO GET THE MOST OUT OF PLASTICS

IN solving a material problem, substantial benefits frequently occur which are in addition to those originally anticipated. Such was the case with the Warren Lamp Company, producers of the glass-bodied plug fuses illustrated above.

The problem which this company's research department set out to solve was to lighten the over-all weight of the plug fuse without sacrificing its quality. The reason for this attempt to lighten their product is obvious when you realize that it is the policy in the electrical manufacturing trade to prepay freight charges on all shipments up to 100 pounds.

As no other transparent material has the inertness of hard glass and as there is no satisfactory substitute for brass, the only part of the fuse that could be altered was the tip.

In the past it had been customary to use another type of mineral-filled material for this fuse tip. However, after extensive experimentation, it was found that by changing to a cellulose-filled Durez molding compound a substantial saving in weight resulted. This was because cross-sectional areas could be made much thinner due to the fact that the part molded from Durez was ten times as strong as the material previously used.

In addition to this weight-saving feature, reductions in production costs and time were achieved through a specially designed molding process, which substantially reduced the molding cycle. *Another example of the effectiveness of co-operative effort between the design engineer custom molder and plastics producer.*

The versatility of the more than 300 Durez phenolic molding compounds in conjunction with the vast experience of Durez technicians make Durez' services extremely valuable to the design engineer with imaginative ideas. You can count on the complete cooperation of the Durez staff at all times in helping you and your custom molder work out any materials problem which you may have. Durez Plastics & Chemicals, Inc., 261 Walck Road, N. Tonawanda, N. Y.

DUREZ } PHENOLIC RESINS — MOLDING COMPOUNDS; INDUSTRIAL RESINS; OIL SOLUBLE RESINS

PLASTICS THAT FIT THE JOB


THE GEM OF PLASTICS
Catalin
Will the coming products for a world at peace project themselves at war's tempo? Will speed, mass production and standardization characterize the future?
In some degree, yes! But . . . midst the rush back into open competition and replacement, there will also be the surge to start afresh—to create—to draw inspiration from and emulate the masters of honored achievement.
For those who, with plastics, choose the latter approach to product fame, there will be Catalin...the gem of all plastics! Its incomparable beauty, unrivalled color richness and unmatchable quality offer most to both the designer and manufacturer.
CATALIN CORPORATION
ONE PARK AVENUE, NEW YORK 16, N. Y.
CAST RESINS • LIQUID RESINS
MOLDING COMPOUNDS
S. GRECO

MODERN PLASTICS

AND PLASTICS

CHARLES A. BRESKIN, *Editor and Publisher*
HARRIET B. JOSEPHS, *Assistant Publisher*
DOROTHY MARTIN, *Managing Editor*
DR. GORDON M. KLINE, *Technical Editor*
FRED B. STANLEY, *Engineering Editor*
LAURA E. MORRISON, *Associate Editor*
ELLEN M. LYNN, *Associate Editor*
SHIRLEY SMARR, *Assistant Editor*
LOUISE GOTTESMAN, *Editorial Assistant*
R. L. VAN BOSKIRK, *Washington Editor*
PAUL D. AIRD, *Contributing Editor*
KATHLEEN SKELTON, *Contributing Editor*
DORIS BRIAN, *Contributing Editor*
E. N. MOORE, *Contributing Editor*
F. M. TANENHAUS, *Readers' Service*
JOSEPH BOLOGNA, *Art Director*

BUSINESS STAFF

ALAN S. COLE, *General Manager*
P. H. BACKSTROM M. A. OLSEN
DANIEL M. BROADS, *Production*
WALTER S. ROSS, *Circulation Director*

J. M. CONNORS
221 N. La Salle St., Chicago 1, Ill.

R. C. BEGGS
815 Superior Ave., Cleveland 14, Ohio

L. B. CHAPPELL
427 West 5th St., Los Angeles 13, Calif.

All editorial contents bearing on military subjects have been released for publication by the Armed Services.

MODERN PLASTICS is regularly indexed in the Industrial Arts Index.

Member Audit Bureau of Circulations

EXECUTIVE and EDITORIAL OFFICES: 122 E. 42nd St., New York 17, N. Y. WASHINGTON 6, D. C., OFFICE: 625 Colorado Bldg., 14th & G Sts. Published the 1st of each month by Modern Plastics, Incorporated. Publication Office, Twentieth and Northampton Sts., Easton, Pa. Subscription price $5.00 per year, $8.00 for 2 years in U. S., its possessions and South America. Canadian subscriptions $5.50 per year, $9.00 for 2 years; all other countries $6.00 per year, $10.00 for 2 years, payable in American money or its equivalent. Price 50¢ per copy.

Printed in U. S. A. Entered as second class matter May 28, 1940, at the Post Office at Easton, Pa., under the act of March 3, 1879. Member of the Audit Bureau of Circulations. Back numbers 3 months or more preceding current issues, when available, $1.00 each.

VOLUME 22 JANUARY 1945 NUMBER 5

General Section

Plastics—Engineering Section

Technical Section

News and Features

With Geon it's the *combination* of properties that counts

THAT flexible plastic film in the picture is 4/1000 of an inch thick. Yet it remains unaffected even by nitric acid. That's because it's made from one of the GEONS, a new group of polyvinyl materials whose long list of unusual properties includes resistance to acids and other corrosive chemicals.

But one property is important chiefly in its relationship to other properties. That's why we say, with GEON it's the *combination* of properties that counts. Examine this list. Try to imagine the thousands of combinations that can be obtained from it.

Products of GEON can be made resistant to water, oil, grease, acids, alkalies, sunlight, cold, heat, aging, air, ozone, abrasion, flame, mildew, creasing and many others. They may be permanently flexible, waterproof, light weight, odorless, tasteless. They can be made in a wide range of colors. And they can be heat sealed.

GEON can be extruded, pressure or injection molded. It can be calendered or cast into sheet or film. It may be used as a coating for textiles and papers of all kinds. Its almost limitless applications extend into the plastics, packaging, textile, food, rubber, paper, clothing, shoe and many other fields. Probably many of its most important applications have yet to be developed.

Right now all the GEONS are subject to allocation by the War Production Board. Limited quantities may be had for experiment. And our development staff and laboratory facilities are available to help you work out any special problem or applications. For more complete information write Department II-1, Chemical Division, The B. F. Goodrich Company, 324 Rose Building, E. Ninth and Prospect, Cleveland 15, Ohio.

Geon
Polyvinyl Materials

CHEMICAL DIVISION
THE B. F. GOODRICH COMPANY
ROSE BUILDING, E. NINTH & PROSPECT, CLEVELAND 15, OHIO

How Molded INSUROK Solved

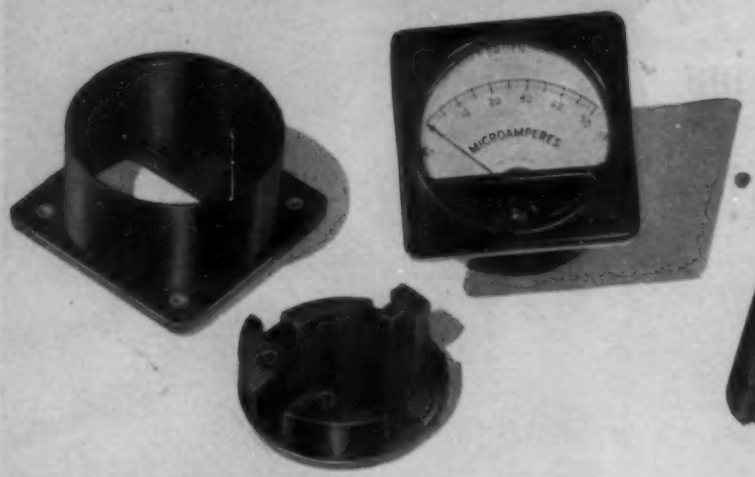
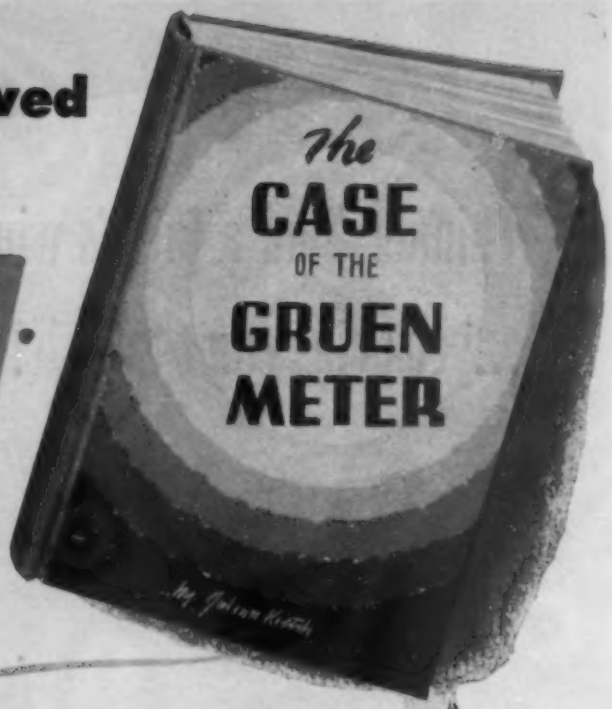


Exhibit A-B-and-C: Individual parts and completed Meter Case, made of Molded INSUROK for the Gruen Watch Company. (Note metal inserts in base)



THESE WERE THE FACTS: The Gruen Watch Company of Cincinnati, Ohio, needed plastic cases for vital electrical indicating instruments. The material requirements included: *dielectric strength, lightness of weight, durability,* and *permanent finish.*

This evidence pointed unquestionably to Molded INSUROK, Grade 1—and another "case" was solved! To Richardson Plasticians, there is no mystery in such problems, for they have the knowledge . . . based on many years of experience . . . of how INSUROK Precision Plastics can most efficiently and economically be used.

There are many grades and types of INSUROK . . . both Molded and Laminated. One or more of these will meet practically every electrical, chemical or mechanical requirement.

Richardson Plasticians are always available to work with you in determining which grade of Molded or Laminated INSUROK is best suited to your problem. Feel free to call upon them . . . without obligation.

INSUROK *Precision Plastics*

The RICHARDSON COMPANY

MELROSE PARK, ILL. · NEW BRUNSWICK, N. J. · FOUNDED 1858 · INDIANAPOLIS 1, IND. · LOCKLAND (CINCINNATI 15) OHIO
DETROIT OFFICE: 6-252 G. M. BUILDING, DETROIT 2, MICHIGAN · NEW YORK OFFICE: 75 WEST STREET, NEW YORK 6, N. Y.
CLEVELAND OFFICE: 126-7 PLYMOUTH BLDG., CLEVELAND 15, OHIO

JET PROPELLED! "LUCITE" ENCLOSED!

TOP AND SIDE OF COCKPIT ON

BELL AIRCRAFT'S P-59A AIRACOMET

Protected by Du Pont "Lucite" Methyl Methacrylate Resin Sheets

CHIEF distinction of this Army Air Force jet-propelled plane is the absence of a propeller—which allows it to be built low to the ground. Weighing more than five tons, the P-59A Airacomet is practically vibrationless and has a speed of over 400 miles per hour—driven by the powerful thrust of the gases leaving the nozzles of the jet engines.

Transparent enclosures of "Lucite" methyl methacrylate resin are installed in the top and side sections of the cockpit canopy. In addition, a dome-shaped lens of "Lucite" protects the landing light located in the tip of the nose.

The crystal-clear *transparency*, light weight, excellent tensile properties, ease of forming, finishing and mounting make it suitable for a wide variety of aircraft applications.

E. I. du Pont de Nemours & Co. (Inc.), Plastics Department, Arlington, N. J., or 5801 South Broadway, Los Angeles 3, California. In Canada: Canadian Industries, Ltd., Box 10, Montreal.

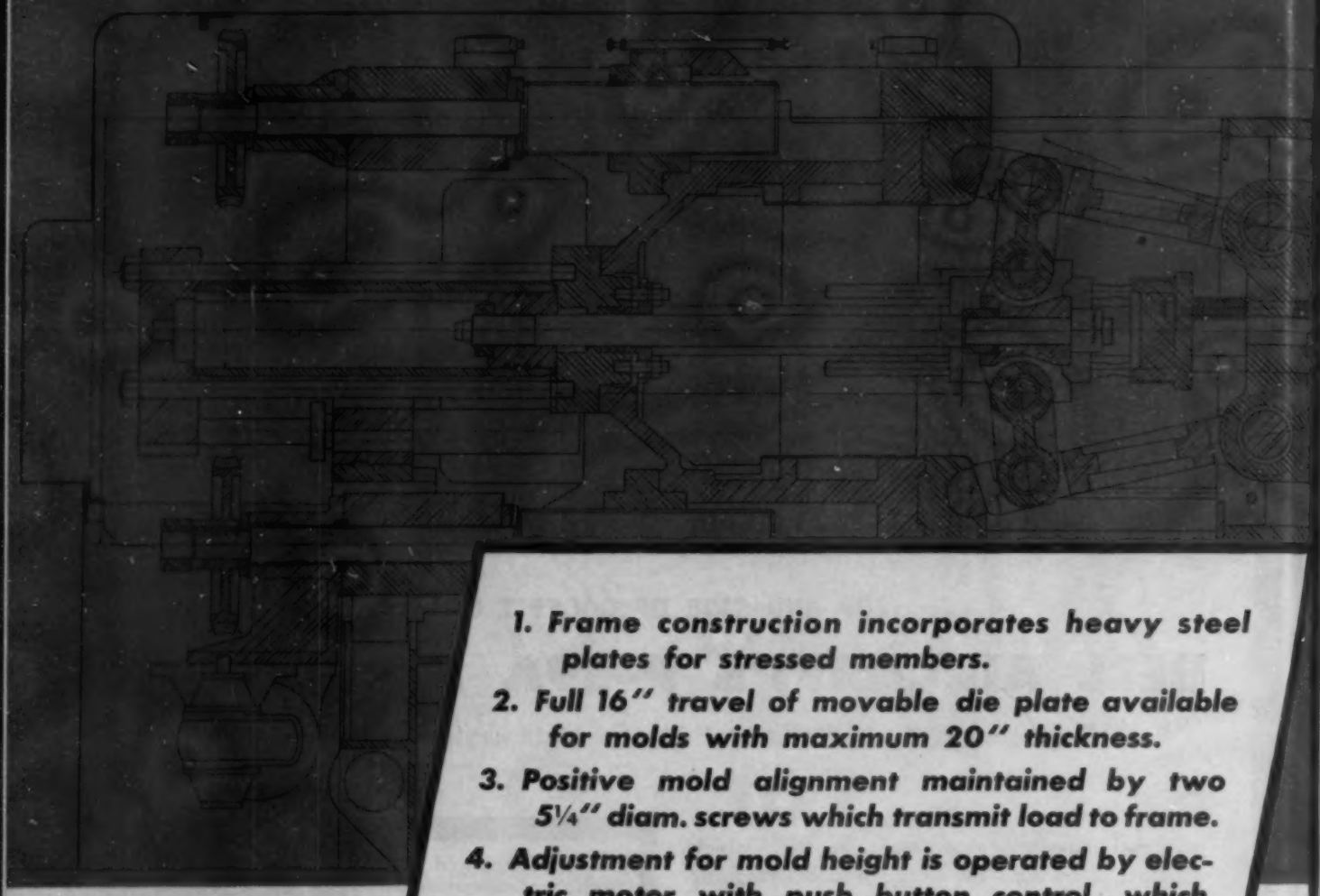
These are top and side sections of cockpit enclosure. Worker is polishing dome-shaped "Lucite" landing light lens.

DU PONT

DU PONT PLASTICS

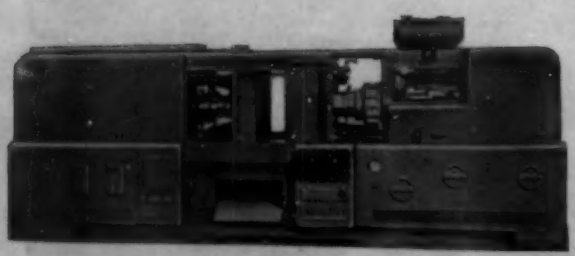
BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

REED-PRENTICE Positive Mechanical Mold Clamping Offers Important Advantages



1. Frame construction incorporates heavy steel plates for stressed members.
2. Full 16" travel of movable die plate available for molds with maximum 20" thickness.
3. Positive mold alignment maintained by two 5¼" diam. screws which transmit load to frame.
4. Adjustment for mold height is operated by electric motor with push button control, which actuates both screws.

All of these above features are available on both 10F-16 oz. and 10H-22 oz. machines



SPECIFICATIONS	10F-16 OZ.	10H-22 OZ.
Ounces molded per shot	16	22
Mold closing pressure, tons	400	600
Mold opens	16"	16"
Maximum die height	20"	20"
Minimum die height	8"	8"
Pressure on material, lbs. per sq. in.	27,000	28,000
Size of die plates in inches	30" x 30"	30" x 30"
Motor required, 1200 R. P. M.	50 H. P.	50 H. P.

INJECTION MACHINES

REED-PRENTICE CORP.

WORCESTER MASS., U.S.A.

NEW YORK OFFICE
75 West St.
New York 6, N. Y.
CLEVELAND OFFICE
1213 W. 3rd St.
Cleveland 13, Ohio

DOMESTIC: DETROIT — Kordenbrock Machinery Co. CHICAGO — Nett Kohlbusch & Bissell. SAN FRANCISCO — Osborne Machinery Co. LOS ANGELES — Mc Machinery Co. GRAND RAPIDS — Joseph Monahan. SYRACUSE — J. F. Owens Machinery Co. HOUSTON — Preston Machine Tool Sales. MINNEAPOLIS — Chas W. Stone Company. FOREIGN: CANADA, TORONTO, MONTREAL, WINDSOR — F. F. Barber Machinery Co. SOUTH AFRICA — National Engineering, Ltd., Johannesburg. ENGLAND — Alfred Herbert, Ltd., Coventry. AUSTRALIA — Associated Machine Tools Australia, Sydney. INDIA — Alfred Herbert Ltd., Calcutta.

There's no more dramatic proof of Lumarith's toughness than its use in the advanced rocket equipment of the Thunderbolt and other famed warplanes.

Think of the great strides plastics have achieved to meet the challenges of war needs. If your peacetime production plans include the use of advanced plastics, we urge you to consult our Technical Service Department. Its staff welcomes challenging problems of reconversion.

Celanese Celluloid Corporation, a *division of Celanese Corporation of America*, 180 Madison Avenue, New York City 16.

A Celanese Plastic*

*Reg. U. S. Pat. Off.

Reproduced from original designed for the September issue of Air News by Robert Lindgren, Art Editor.

PRE-CAUTION!

As the burnt child
fears the fire,
so some sales
and production executives,
once burnt by plastics,
hesitate to try them again.
...What was wrong?
Ask us,
and perhaps we can tell you.
Remember, our vast experience
is an excellent unguent
which guards you
against being burnt by plastics.
We are big, unbiased molders
of all plastics, by all processes,
with no axe to grind
but your own.

HAVE YOU A PLASTICS PROBLEM?

PROLON PLASTICS

INCREASE PRODUCTION! IMPROVE FINISH!

Abolish ~~DISCOLORATION~~ ~~DISTORTION~~ ~~FLOW~~

PORTER-CABLE

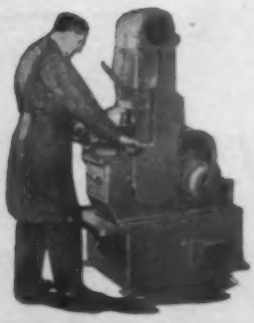
WET OR DRY ABRASIVE BELT SURFACER

MODEL B-6W — especially designed for curved or irregular work. Most jobs can be handled freehand, or with simple fixtures. A single pass in a fraction of the usual time — cuts cost and improves the finish.

Does them all on PLASTICS . . .

For thermoplastics and some thermo-setting plastics, experience has shown that the PORTER-CABLE Surfacing methods are best. In Wet-Belt Surfacing, the coolant is sprayed on the belt before and after cutting, keeping it free and clean. Because there is no heat, the grindings do not "weld" and load the belt. Wet or Dry—the PORTER-CABLE Surfacing technique does a better, closer, finer job because a flexible belt follows the contour and gets into places other power tools won't reach. For repeat operations a padded platen fits the belt to the contour of the job. Round pieces, held on an arbor, rotate with the belt for perfect roundness.

HERE ARE ALL THE FACTS WRITE TODAY for your FREE copy of the handbook, "A New Precision Machining Method." It describes a process as new — as vital — as the Plastics industry itself!



MODEL G-8 — for close-limit work on a high-production basis. Semi-skilled, even "green" operators, can finish true flats to close limits of flatness and parallelism. Single pieces can be finished freehand, or mounted in gang jigs for simultaneous finishing of several parts in one pass.

PORTER-CABLE MACHINE CO.

1606-1 N. Salina St., Syracuse, N. Y.

Please send me a copy of "A New Precision Machining Method."

Name..... Position.....

Company.....

Street.....

City..... State.....

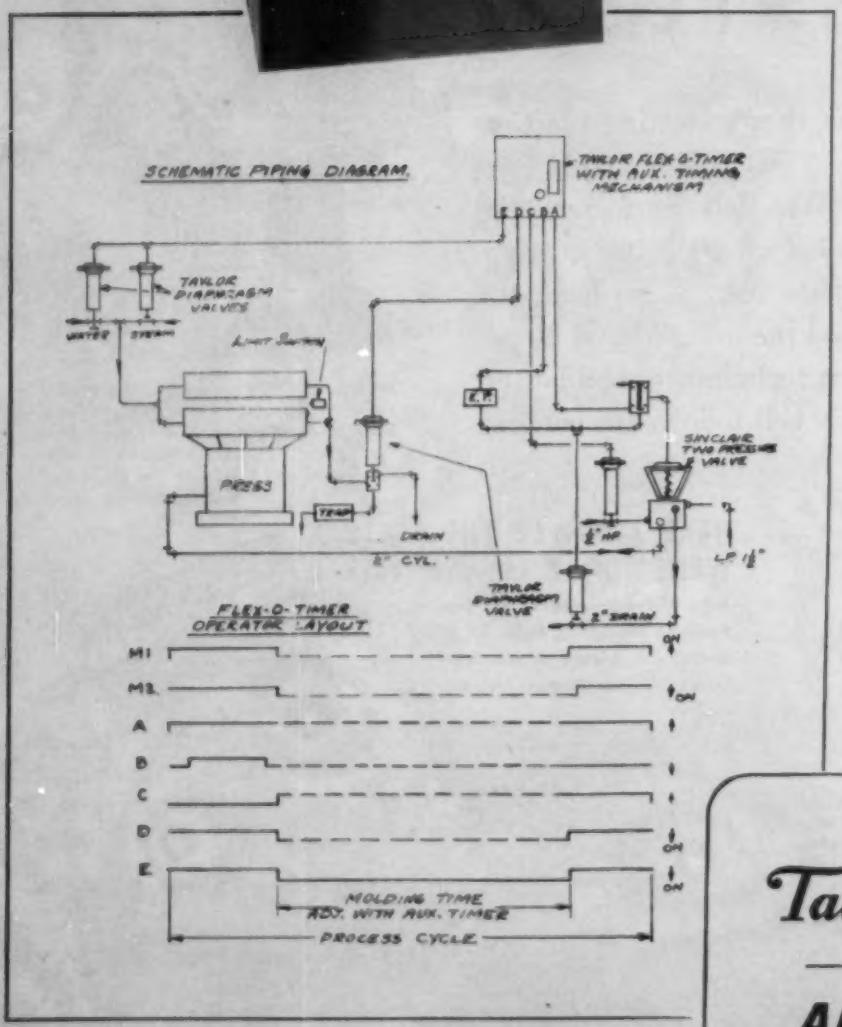
How would you do it?

How would you follow a molding schedule like this?

We can see how you *could* do the whole job by hand if you were careful.

But darned if we can see *why*, when you can do it *automatically* just by hooking up a Taylor Flex-O-Timer!

1. Start press closing—steam in on platens
2. Stop it 1 inch from closed position
3. Close
4. Bump
5. Shut off steam—turn on water
6. Mold
7. Open press
8. Turn on steam



Here's how we'd do it!

What we do is lay out the piping as shown in the drawing at left, and set up the Flex-O-Timer so that it literally "takes charge" of the whole molding operation. This takes time, but you don't have to do it—*we* do! And once you get a setup like this, you can adapt it to any experimental changes, any new materials you want to try. This control setup assures consistently uniform quality from each press load; less lost time between loads; and increased production from each working day.

Call your Taylor Field Engineer—or write us today. You'll be glad you did! Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada.

★ ★ KEEP ON BUYING ★ ★
U. S. WAR BONDS AND STAMPS

ARMY NAVY

Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY

Facilities for Fabricating

PLASTIC PARTS

to Precision Specifications

P-G

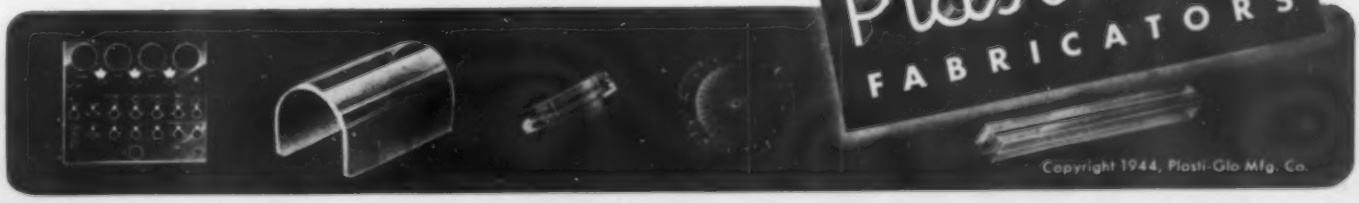
Plastic parts fabricated by P-G are rendering valiant service for victory on every war front. And now the same dependable quality production facilities, engineering experience, and designing skill which enabled us to meet the most exacting Army and Navy requirements are also available for new assignments. Our fabricating processes include drawing, forming, machining, drilling, polishing, engraving, screening and complete finishing. Our exclusive cements and cementing technique assure maximum strength and clarity of bond on both regular and irregular surfaces. Any part or product—regardless of size, shape or design assembly—economically manufactured to rigid tolerances. No molds required! . . . *Your inquiry is invited.*

PLASTI-GLO MANUFACTURING CO.

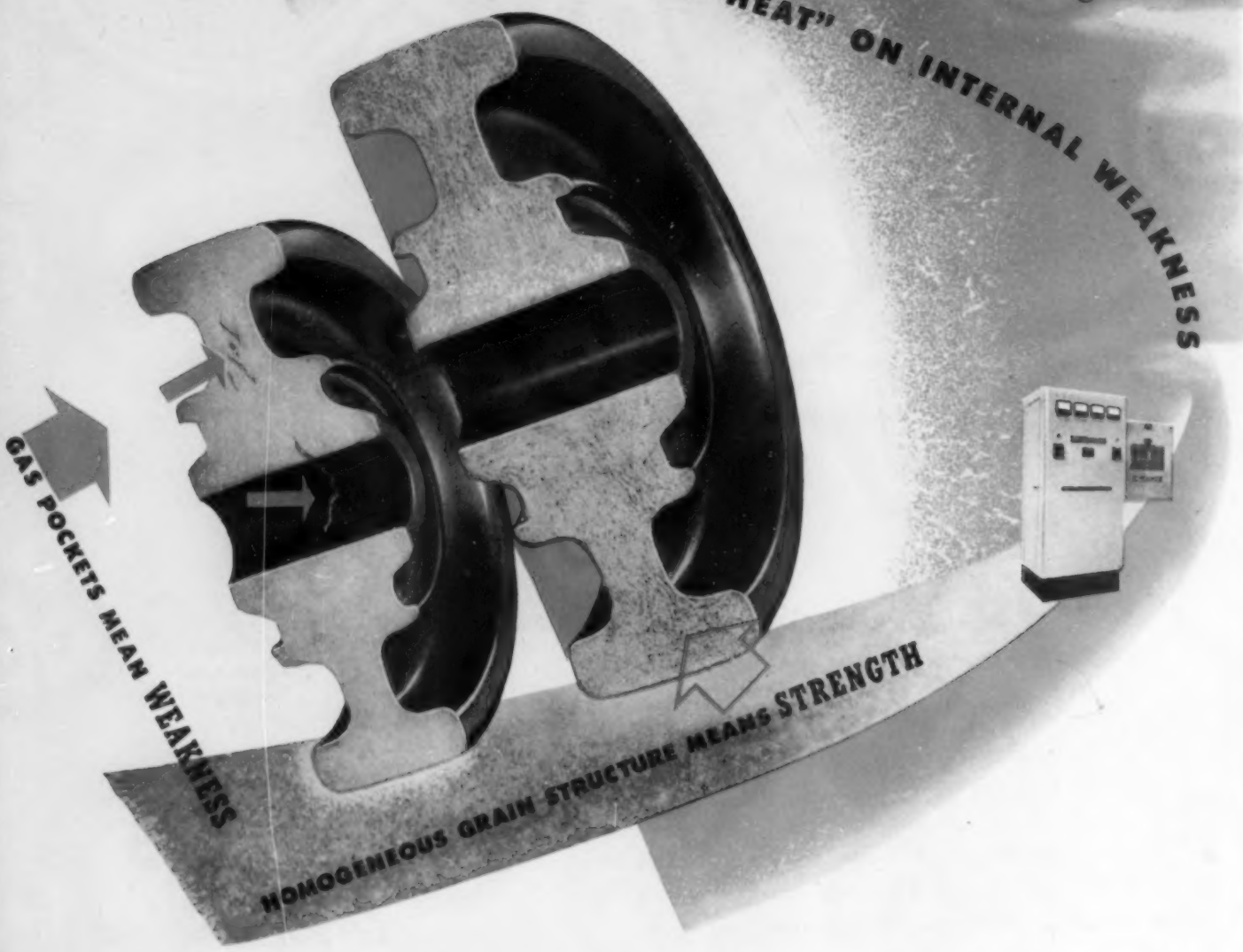
1832 IRVING PARK ROAD, CHICAGO 13, ILL.

PRECISION FABRICATORS OF PLASTICS FOR INDUSTRY

Plasti-Glo FABRICATORS



PLASTIC KNOW-HOW "PUTS THE HEAT" ON INTERNAL WEAKNESS



See that gas pocket? It's a trouble-spot . . . a center of internal stress and potential break-down. The formation of such gas pockets was one of the problems that plagued molders of thick sections like these truck casters. Their prevention required lengthening the curing period . . . which ran up production costs, and involved danger of scorching the piece.

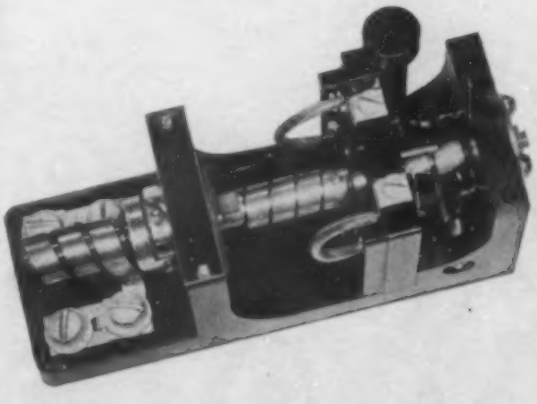
Here, at Molded Products, we literally "put the heat" on this problem . . . by pre-heating the pieces with Federal Megatherm Electronic Equipment. As a result, our molding cycle was cut in half. Costs were slashed. And for load carrying capacity, these plastic casters stand right up to the metal wheels which they are rapidly replacing.

We have the equipment . . . and the "know-how" to use it for solving complicated molding problems. Ask one of our engineers to consult with you, or send us specifications for quotations on your molded parts or products. MOLDED PRODUCTS COMPANY, 4533 W. Harrison St., Chicago (24) Ill.

PLASTICS DIVISION

MOLDED PRODUCTS

PLASTICS IN VITAL MARINE CONTROL EQUIPMENT



• Watertown is producing these five essential parts for vital marine control equipment. They are transfer molded to provide maximum accuracy because alignment of the parts is all important.

Made from Resinox, Bakelite and Durez, each part embodies multiple inserts and is molded in multiple cavity molds. The sections are especially designed to withstand high impact and vibration. They are visible proof of what engineering skill combined with experienced molding techniques can produce in intricate sections held to exacting tolerances.

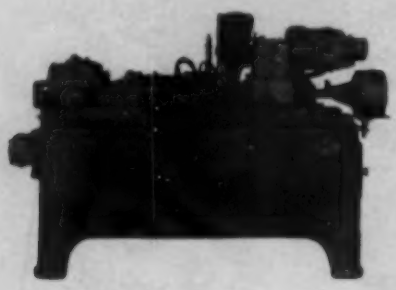
The Watertown Manufacturing Company, Watertown, Connecticut. Branch office — Cleveland. Sales offices — New York, Chicago, Detroit, Milwaukee and Hawaii.

Watertown

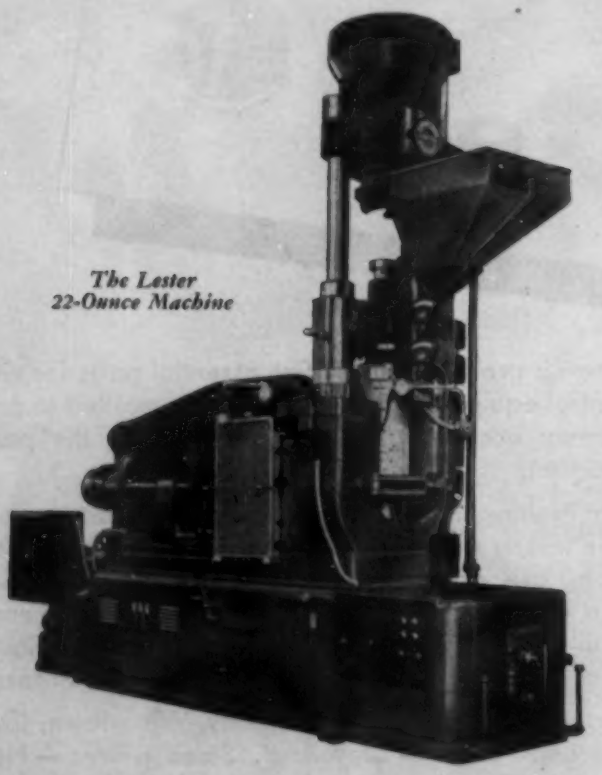
A NAME AS OLD AS THE PLASTICS INDUSTRY

INJECTION MOLDING

THE history of plastic injection molding in America is a short one, and it is doubtful whether any other basic fabricating process has ever developed as rapidly

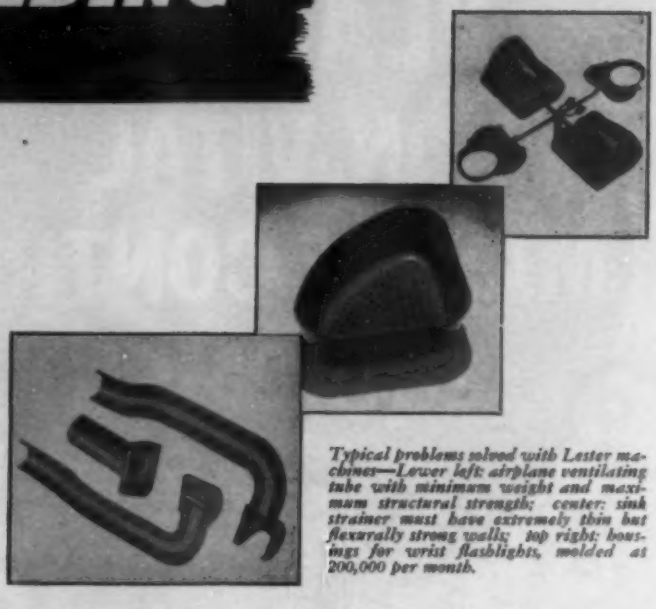


in size and importance. Although various patents relating to this process were granted as early as 1856, its start in America dates from 1934, when Joe Geers of the Index Machinery Corporation in Cincinnati imported the first Isoma molding machine (see above) from Germany.



The Lester 22-Ounce Machine

The Isoma brought relatively high-speed molding production to America, but offered an injection capacity of only ½ to 1½ ounces per cycle, and was capable only of molding small articles such as buttons and pocket combs. It remained for the first Lester injection molding machine, built along new and superior



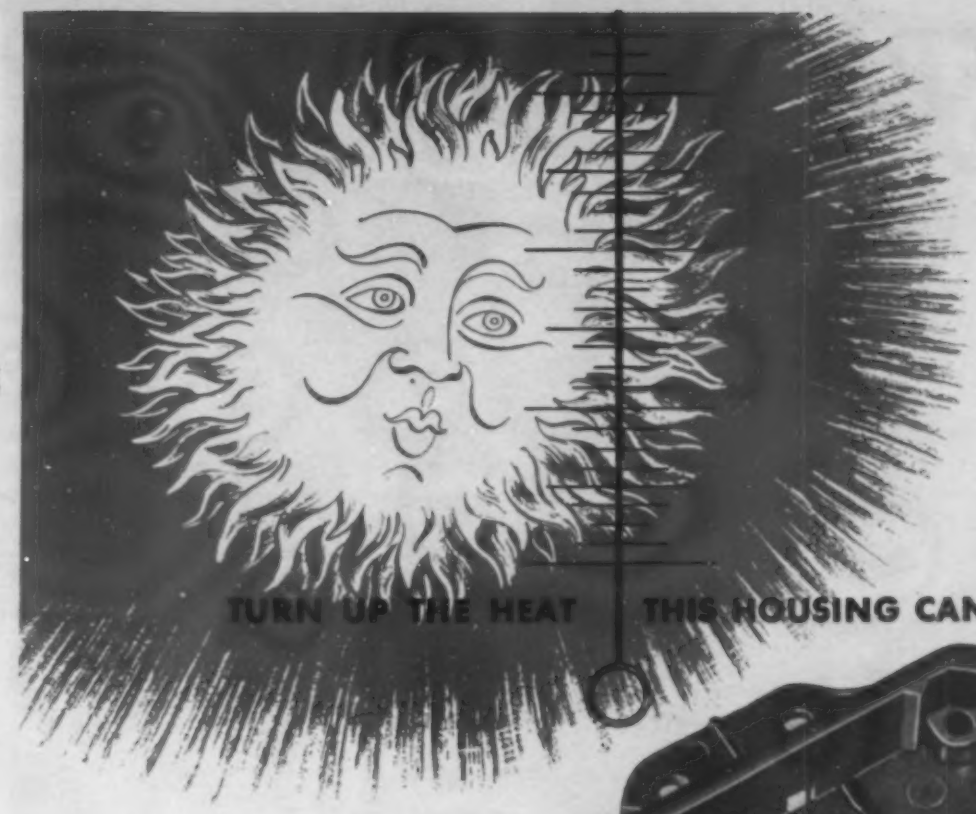
Typical problems solved with Lester machines—Lower left: airplane ventilating tube with minimum weight and maximum structural strength; center: sink strainer must have extremely thin but flexurally strong walls; top right: housings for wrist flashlights, molded at 200,000 per month.

engineering principles in 1937, to lead the way to present-day production efficiency.

Thus Lester machines have helped materially to advance the industry itself. Today the Lester is built in standard models with capacities ranging from 4 to 22 ounces per injection; special machines are designed to meet specific problems. In subsequent advertisements of this series we shall discuss the engineering features embodied in the Lester machine, as well as new developments of general interest to molders. Watch for them.

Injection Mold Design

Islyn Thomas, New York plastics consultant, has written two clear and authoritative articles on the subject of injection mold design, planned to bring together the plastics customer, the sales engineer and the mold designer so that they may reach a better understanding of one another's problems. As a service to the industry we have reprinted these and offer them free to the readers of *Modern Plastics*. Send for your copy today.



TURN UP THE HEAT | THIS HOUSING CAN TAKE IT!

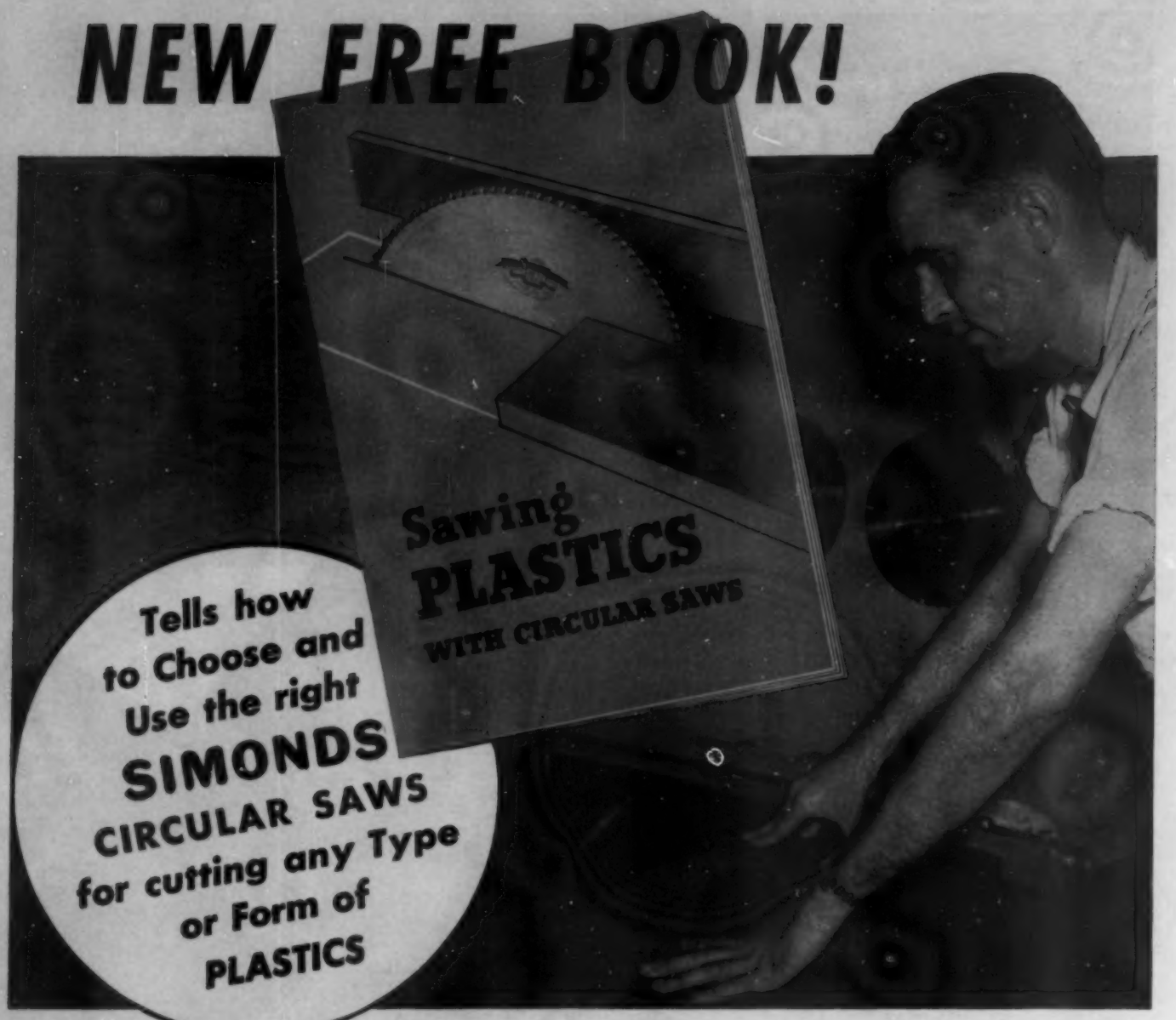
This intricate little box, with its four walls, two balconies and sixteen holes is designed to house and accurately position the working elements of a stove's thermostat.

The material for this non-glamorous, but highly functional role is a specially compounded high heat-resistant black phenolic, compression molded. Accurate processing and closely held tolerances were of prime importance, because each of the sixteen variously sized holes serve to locate and support the stamped metal parts comprising the unit's assemblies. We cite it as an example of Consolidated's ability to reproduce "your blueprint in plastic"... Inquiries invited!

Consolidated MOLDED PRODUCTS *Corporation*

309 CHERRY STREET, SCRANTON 2, PA.
BRANCHES: NEW YORK • BRIDGEPORT
CHICAGO • DETROIT • CLEVELAND

NEW FREE BOOK!



Here, in one handy 5" x 7" book, is all you need to know about plastic-sawing as successfully done by users of all types of plastics in shapes, sheets, molds, bars, and tubes.

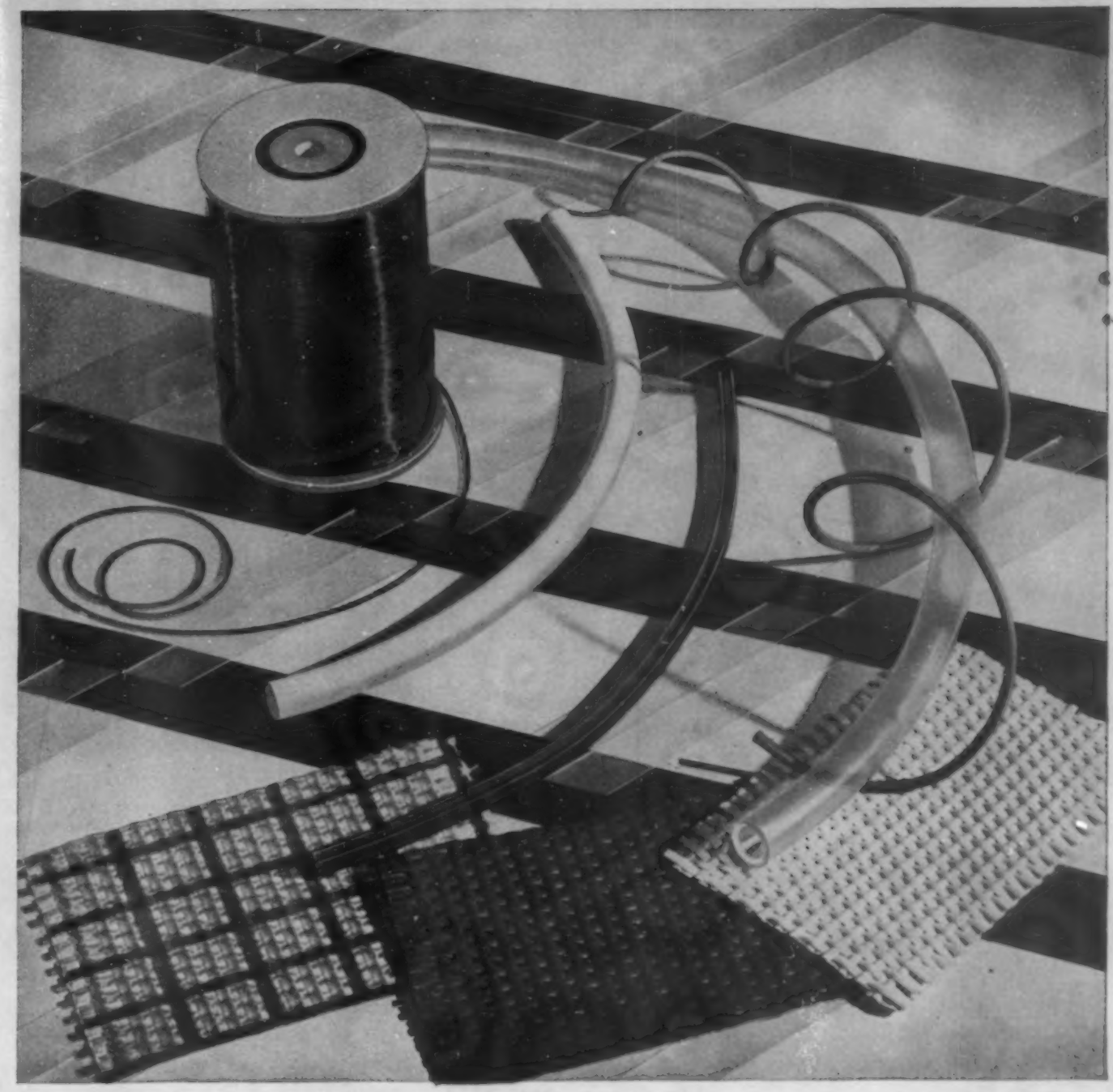
Included are the types of machines and Simonds Saws for each job . . . methods of determining cutting speeds and feeds, saw-tooth spacing, blade diameter and thickness . . . projection of saw through cut . . . and a list of operating points to check for best results. Also, *specifications of all Simonds Saws now available.* Write today for as many copies as you need. And if you have a tough cutting problem, send a sample of your material, addressed to Simonds' Plastic Service Laboratory.

Branch Offices: 1350 Columbia Rd., Boston 27, Mass. • 127 S. Green St., Chicago 7, Ill. • 228 First Ave., San Francisco 5, Calif. • 311 S. W. First Ave., Portland 4, Ore. • 520 First Ave. So., Seattle 4, Wash. • 31 W. Trent Ave., Spokane 8, Wash.

SHORTEN THE WAR — BUY BONDS!

PRODUCTION TOOLS FOR CUTTING METAL, WOOD, PAPER, PLASTICS

SIMONDS
SAW AND STEEL COMPANY
FITCHBURG, MASSACHUSETTS



Fibronized Plastics Have A Place In Your Plans

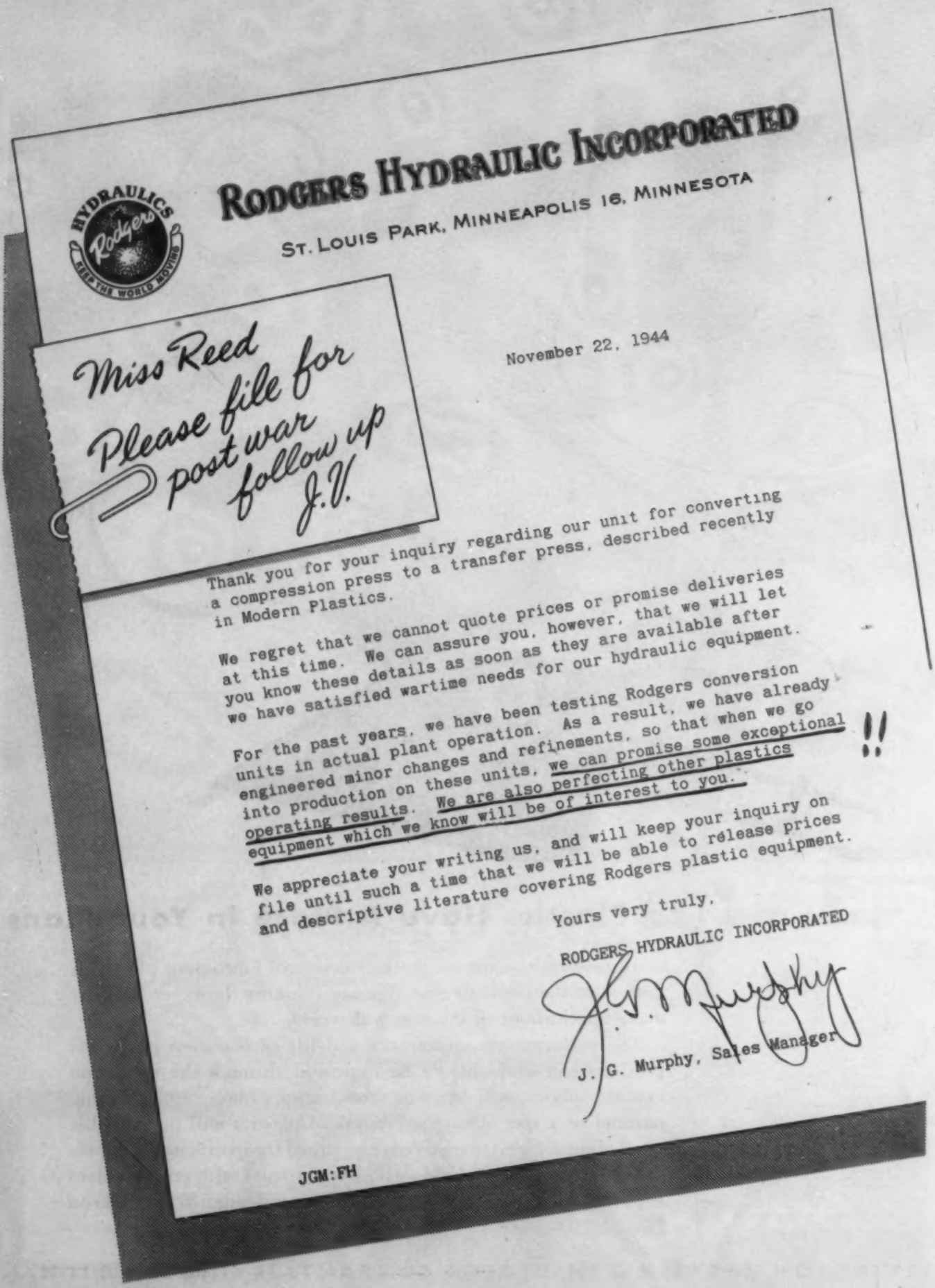
Until victory is achieved, the production of Fibronized plastics is limited to the needs of war. We are thinking, however, of their many applications in the post-war world.

The performance, appearance and life of countless peacetime products can undoubtedly be improved through the use of an extruded plastic, whether it be thread, trim, ribbon, rattan, tubing, channel or a special shape. Fibronized plastics will be available in all of these forms in materials best suited for specific applications.

We will welcome an opportunity to discuss with you the place of Fibronized plastics in your post-war plans. Write Fibron Division, Department 146.

IRVINGTON VARNISH & INSULATOR COMPANY, IRVINGTON 11, N. J.

6344



RODGERS HYDRAULIC INCORPORATED

ST. LOUIS PARK, MINNEAPOLIS 16, MINNESOTA

Miss Reed
Please file for
post war
follow up
J.V.

November 22, 1944

Thank you for your inquiry regarding our unit for converting a compression press to a transfer press, described recently in Modern Plastics.

We regret that we cannot quote prices or promise deliveries at this time. We can assure you, however, that we will let you know these details as soon as they are available after we have satisfied wartime needs for our hydraulic equipment.

For the past years, we have been testing Rodgers conversion units in actual plant operation. As a result, we have already engineered minor changes and refinements, so that when we go into production on these units, we can promise some exceptional operating results. We are also perfecting other plastics equipment which we know will be of interest to you. !!

We appreciate your writing us, and will keep your inquiry on file until such a time that we will be able to release prices and descriptive literature covering Rodgers plastic equipment.

Yours very truly,

RODGERS HYDRAULIC INCORPORATED

J. G. Murphy, Sales Manager

JGM:FH

PRESCRIPTION for Resin Troubles

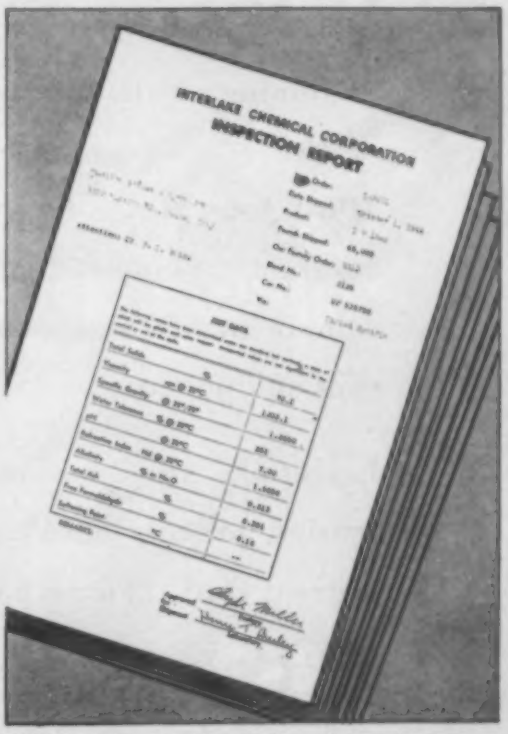
Rx Specificity plus Exacting Laboratory Control at Source

RESINS *not* specifically developed for individual applications, and resins which vary appreciably (from one shipment to another) in chemical or molecular characteristics, are the common causes of users' resin troubles.

But—when a resin is scientifically prepared for only *one* specific application, *job tested*, and its production stabilized—*then* dependable uniformity in satisfactory performance is achieved. Interlake has proved this for large industrial users.

Interlake *specializes* in the development of resins for specific applications and so *stabilizes* production of each specification resin that the performance of *every* shipment delivered is identical with the first.

The extremely close range of variation within which Interlake Resins are held is evidenced by a control laboratory inspection report—*with each shipment*—showing the complete chemical characteristics of the resin.



■ Each shipment of Interlake resin carries its own analytic inspection report from the Interlake Control Laboratory. Thus you can be sure of the *uniformity in performance* of the shipment you receive today—or a year from today. No other supplier provides this exacting evidence of production control.

Interlake Production-Stabilized Resins have been developed to precise requirements of specific applications in coating, impregnating, bonding of . . .

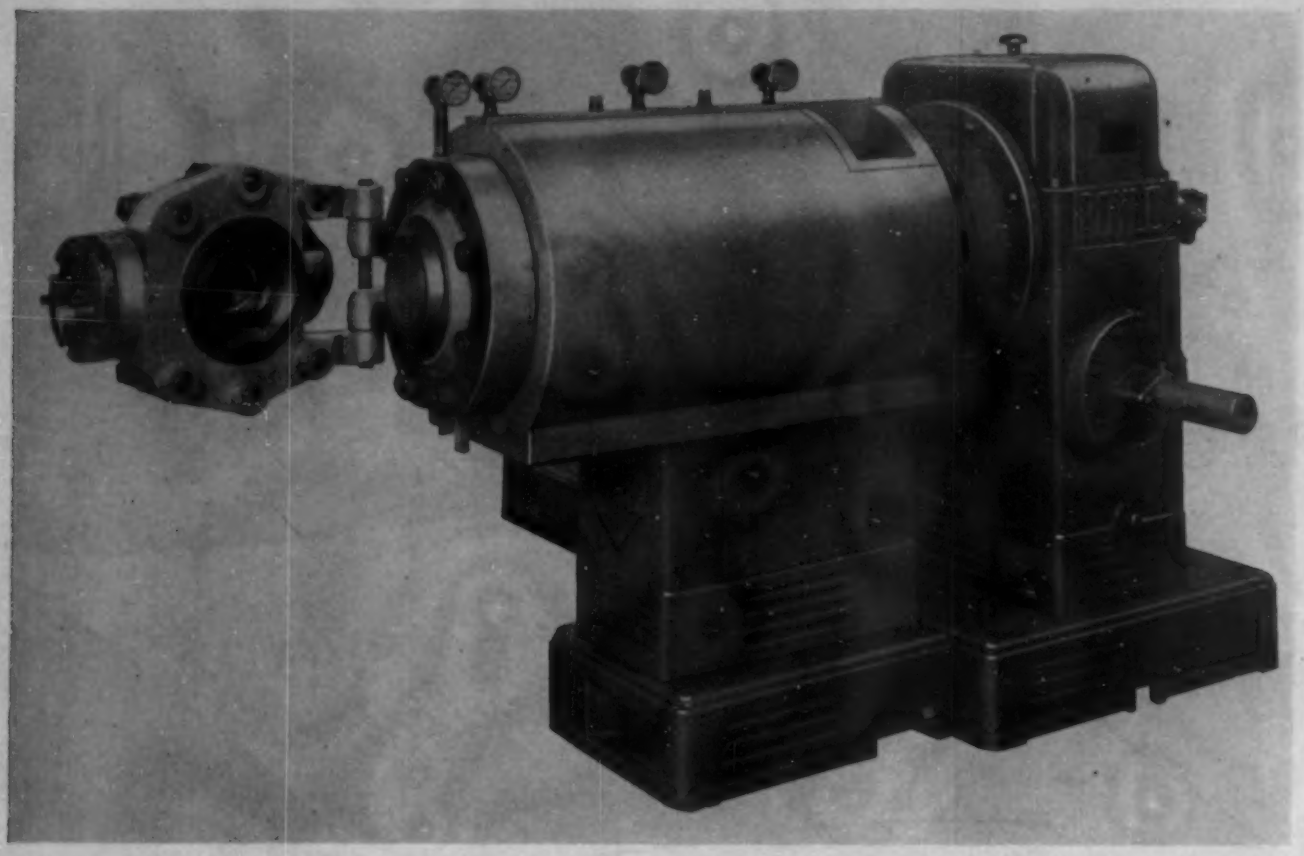
WOOD • PAPER • METAL • GLASS • FIBRE • RUBBER • CELLULOSE • ETC.

IF YOU HAVE A RESIN PROBLEM **draw freely upon the wide experience of Interlake. We will gladly work with you on any resin problem, or discuss with you the possible advantage of using resins in any operation or process. Write Interlake Chemical Corporation, Plastics Division*, Dept. 10, Union Commerce Building, Cleveland 14, Ohio.**

Specificity in RESINS

INTERLAKE CHEMICAL CORPORATION, Plastics Division*

**Formerly Central Process Corporation*



65 YEARS OF PROGRESSIVE PIONEERING

Beginning with the invention of the screw-type machine in 1880 John Royle & Sons have constantly pioneered in the development of continuous extrusion equipment.

Essentially the continuous extrusion process hasn't changed a great deal. There have been refinements—the most apparent being in the field of temperature control and in the development of accessory equipment.

Sixty-five years of progressive pioneering have produced a wealth of knowledge and experience. This "know how" is built into Royle equipment—reflected in performance records.

JOHN ROYLE & SONS

ROYLE
PATERSON
N. J.

PIONEER BUILDERS OF EXTRUSION MACHINES SINCE 1880

Continental Europe
James Bay (Machinery) Ltd.
London, England

Home Office
R. H. Davis J. W. VanRiper
Sherwood 2-8262

Akron, Ohio
J. C. Chenefelter
University 3726

PATERSON 3, NEW JERSEY


When beauty is liberated!
Ever closer on the horizon looms the glorious day of beauty's liberation . . . when the world of plastics will once again be free to devote its talents to glamorous products . . . of beauty, for beauty. Then, as always, Columbia Plastics will be in the forefront . . . reflecting in even greater measure the vision, unexcelled engineering skills, production techniques and facilities that have long made Columbia a leader in plastic molding.
COLUMBIA Plastics
COLUMBIA PROTEKTOSITE CO., INC. · CARLSTADT, N. J.

Beetle
...Adhesive Bond for a Bomber

PHOTOS COURTESY DEHAVILLAND AIRCRAFT OF CANADA, LTD.

In the fastest bomber of its day, the famous DeHavilland *Mosquito*, BEETLE*Cements are used to join together all wood in sub-assemblies in the contruction of the wings and fuselage.

A bond stronger than the wood it unites—this cold-setting resin adhesive was especially developed for the assembly of just such composite wooden structures where all types of joints are encountered—particularly in assembly gluing where complex shapes prohibit perfect joining and uniform high pressures are not applicable to insure thin glue lines. In wood construction, such as prefabricated arches, beams, trusses, wooden truck and bus bodies, boats, furniture, and other wood products, these modified cold-setting adhesives permit economy in toolage, while providing strength and durability.

BEETLE Cements are but part of Cyanamid's complete line of hot and cold-setting synthetic resin adhesives. If you use resin glues or adhesives, get the facts on Cyanamid's products in this field. There is a wide variety to meet all needs. **Reg. U. S. Pat. Off.*

LIFE ON THE PLASTICS NEWSFRONT

AMERICAN CYANAMID COMPANY . PLASTICS DIVISION
30 ROCKEFELLER PLAZA • NEW YORK 20, N Y.

(*Right*) BEETLE Cements, used to assemble bulkhead sealing doors in the *Mosquito* bomber, are modified to eliminate "crazing" and cracking in glue lines.

(*Below*) In such assembly work as the bomber's fuselage shell, glue lines of BEETLE Cement as thick as .020" may be tolerated without sacrifice of dry or wet bond-strength.

Cyanamid Plastics

Beetle · Melmac
Melurac · Laminac
Urac

(*Above*) BEETLE Cements form permanent, strong glue lines in assembly work such as the *Mosquito* wings, where perfect joining is difficult to obtain.

(*Above*) Structural pieces such as those forming the bomb bay door may be assembled with speed and economy with BEETLE Cement.

(*Above*) Where complex shapes like the *Mosquito* fuselage prohibit the application of high, uniform pressures to insure uniformly thin glue lines, BEETLE Cement provides a factor of safety not offered by ordinary urea resin glues.

How SEARCHRAY spots failures before they occur

NORELCO Model 80 (80 kvp) Searchray, completely self-contained, rayproof and shockproof, for either fluoroscopic or radiographic inspection work.

A NORELCO Searchray Model 80 (Industrial X-ray) Unit in the plant of the Heinemann Circuit Breaker Company is playing the important role of spotting failures before they occur.

To insure the excellence of their circuit breakers, the Heinemann Company subjects parts and assemblies to a series of fluoroscopic and radiographic inspections for internal defects. As an added safeguard, the bakelite cases are given a spot radiographic inspection as a check on proper molding technique.

Searchray is shockproof, rayproof and completely self-contained. It gives you all the benefits of *non-destructive* fluoroscopic and radiographic inspection without the expense and inconvenience of a space-consuming, lead-lined room. Easily, safely operated by quickly trained factory personnel, it reveals internal details hidden to the eye, on most types of molded products. Voids, inclusions, case hardening, shrinkage, the proper placement or absence of metal inserts, are quickly disclosed. When used as a guide to quality, Searchray 80 shows up incorrect molding temperature, pressure, cycle or formula through easily interpreted changes in the internal characteristics of the molded pieces.

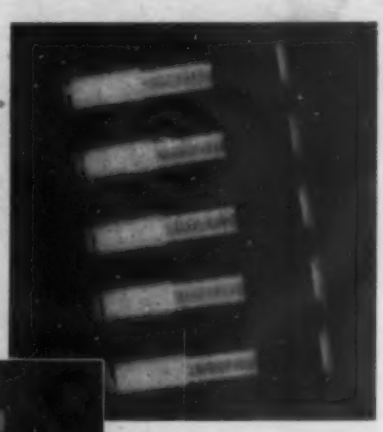
For heavier duty radiographic and fluoroscopic inspection Searchray 150 (150 kvp), in self-contained and conveyor units, is recommended.

Improve your competitive position by putting Searchray to work in your plant. Searchray is produced by an organization with an impressive record of achievements in electrical developments extending over a half century. Send the coupon below for descriptive literature, including leaflet on application of Searchray to plastics manufacturing.

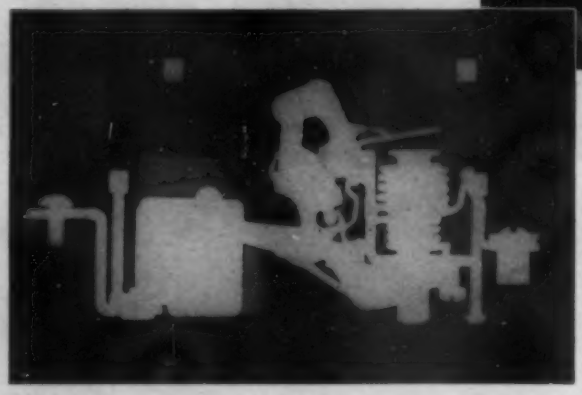
• • •

NORELCO ELECTRONIC PRODUCTS also include X-ray Diffraction Apparatus; Geiger-Counter X-ray Spectrometer; X-ray Quartz Analysis Apparatus; Medical X-ray Equipment, Tubes and Accessories; Quartz Oscillator Plates; Amplifier, Transmitting, Rectifier and Cathode Ray Tubes; Tungsten and Molybdenum products; Fine Wire; Diamond Dies.

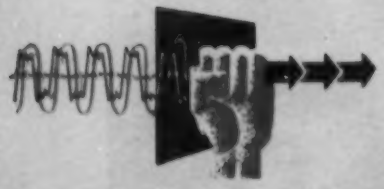
When in New York, be sure to visit our Industrial Electronics Showroom



Operation of the circuit breakers depends upon the performance of these plunger-type solenoid cores. Searchray radiograph shows perfect construction and alignment of internal parts.



Searchray radiograph of completely assembled Heinemann Circuit Breaker shows that all internal parts are correctly positioned in bakelite housing.



Norelco

Reg. U. S. Pat. Off.

ELECTRONIC PRODUCTS by

NORTH AMERICAN PHILIPS COMPANY, INC.

Executive Offices: 100 East 42nd Street, New York 17, N. Y.
Factories in Dobbs Ferry, N. Y.; Mount Vernon, N. Y. (Metalix Div.); Lewiston, Me. (Elmet Div.)
Represented in Canada by Philips Industries, Ltd., Sun Life Bldg., Montreal, Centre 2;
in England by Philips Lamps, Ltd., Century House, Shaftesbury Avenue, London, W.C.2.

North American Philips Company, Inc.
100 East 42nd Street, New York 17, N. Y.

Gentlemen:
Kindly mail descriptive literature on Searchray and application leaflet on plastics to:

Name_____

Title_____

Company_____

Address_____

N-1

Guidance

. . . is the first of many complete services we offer in satisfying your plastic needs. Selection of the proper plastic materials is of primary importance in the production of your product. For postwar plastics, think of Bridgeport.

BRIDGEPORT MOULDED PRODUCTS, INCORPORATED

BRIDGEPORT CONNECTICUT

Continental-Diamond
Engineered Non-Metallic Materials

The DILECTO punched part illustrated is a stator for an aircraft booster switch. It must of course have high dielectric properties. It must also be strong enough to support current carrying parts, and not deteriorate from vibration and impact shock. Its dielectric properties must be stable regardless of temperature, humidity or dryness. Finally it had to be made from a material that could be accurately punched. DILECTO met all these requirements with a wide margin of safety.

KE-45

C-D PRODUCTS

The Plastics

DILECTO—A Laminated Phenolic.
CELORON—A Molded Phenolic.
DILECTENE—A Pure Resin Plastic Especially Suited to U-H-F Insulation.
HAVEG—Plastic Chemical Equipment, Pipe, Valves and Fittings.

The NON-Metallics

DIAMOND Vulcanized FIBRE
VULCOID—Resin Impregnated Vulcanized Fibre.
MICABOND—Built-Up Mica Electrical Insulation.

Standard and Special Forms

Available in Standard Sheets, Rods and Tubes; and Parts Fabricated, Formed or Molded to Specifications.

Descriptive Literature

Bulletin GF gives Comprehensive Data on all C-D Products. Individual Catalogs are also Available.

There are many grades of DILECTO. Each developed to meet specific electrical, mechanical, chemical or thermal problems. Special grades can be developed to meet unusual problems. DILECTO is also available in combination with Diamond Fibre to still further enlarge its sphere of usefulness. This C-D NON-metallic may be the answer to your "What Material?" problem, in your present and future products, whether used in the air, on land or sea.

DISTRICT OFFICES
NEW YORK 17 • CLEVELAND 14 • CHICAGO 11
SPARTANBURG, S. C. • SALES OFFICES IN PRINCIPAL CITIES

•

WEST COAST REPRESENTATIVES
MARWOOD LTD., SAN FRANCISCO 3

•

IN CANADA:
DIAMOND STATE FIBRE CO. OF CANADA, LTD., TORONTO 8

Continental-Diamond FIBRE COMPANY

Established 1895. . Manufacturers of Laminated Plastics since 1911—NEWARK 28 • DELAWARE

Double Production with your present presses and mold equipment

IT'S not a dream. It's being done, right now, in plenty of plastics plants—with the help of Thermex high frequency heating equipment. By heating uniformly in a fraction of the usual time, Thermex speeds up cycles, supplies material as fast as presses can handle it.

Improved quality and greater structural strength in the finished product result from the use of fully automatic, portable Thermex units. Number of rejects is minimized because of uniform heating—no cores, no granular or spongy moldings. Molding pressures are reduced 50% or more, molds last longer.

Write for full information on the new line of Thermex Red Heads, developed expressly for the plastics industry. Portable, automatic, self-contained. The Girdler Corporation, Thermex Division, Louisville 1, Ky.

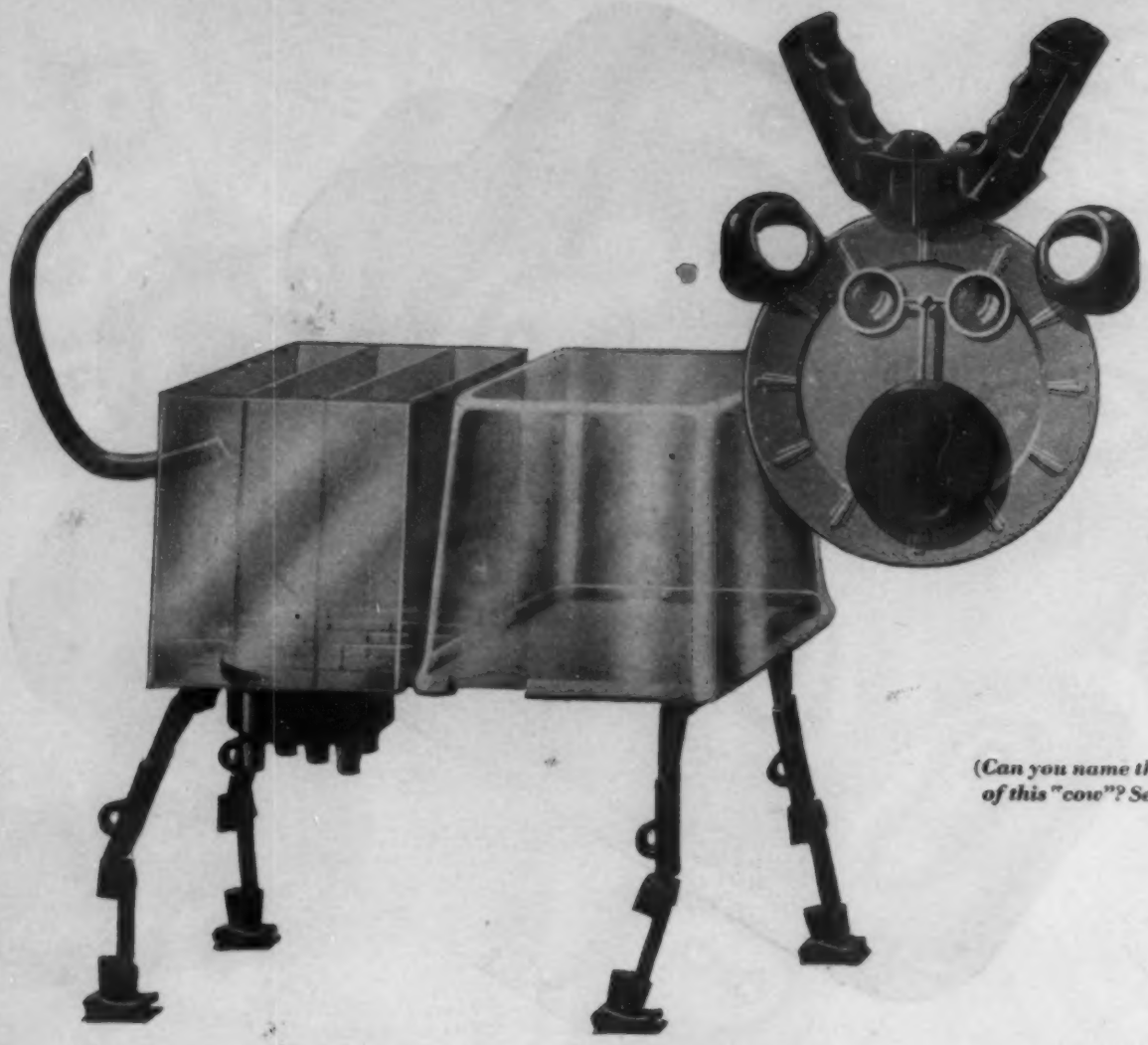
Model 28XO

Thermex

A GIRDLER PRODUCT

RED HEAD

THE FIRST INDUSTRIAL HIGH FREQUENCY DIELECTRIC HEATING EQUIPMENT



(Can you name the plastic parts of this "cow"? See chart below.)

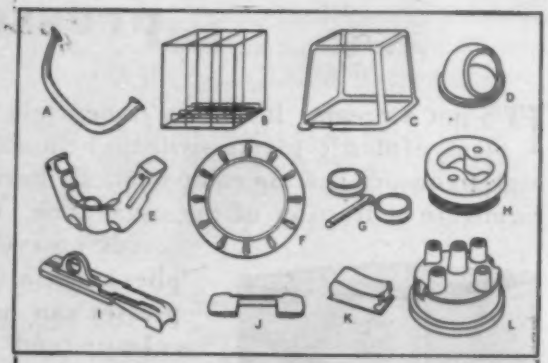
How to milk more efficiency out of your product

No need to beef over the problem of bringing out a new product or improving an old one. Continental's Plastics Division, with years of experience in planning and producing a wide variety of successful plastic products, can give you a good steer.

Our designers, engineers and research men are in close touch with the foremost manufacturers of raw materials, and will work with them to select the plastic best fitted for your requirements.*

No matter which modern fabricating techniques your product requires — compression, injection, extrusion, lamination or sheet forming—it will be handled in the most efficient and economical way.

You can count on Continental to give your product the exact features it should have—beauty, durability, lightness, toughness or anything else. You'll find an alert, progressive organization equipped to offer sound, practical advice and assistance at all times!



(a) Air scoop mounting—compression; (b) Battery case—injection; (c) Dust cover—sheet formed; (d) Mouthpiece for phone—compression; (e) Gunner's handles—compression; (f) Nursery dish—compression; (g) Flashlight lenses—injection; (h) Electrical cap—compression; (i) Power switch lever—compression; (j) Ribbon cover—compression; (k) Trigger for gun handle—compression; (l) Distributor cap—compression.

CONTINENTAL CAN COMPANY, INC.

PLASTICS DIVISION

HEADQUARTERS: Cambridge, Ohio

Sales Representatives in all Principal Cities

COMPRESSION • INJECTION • EXTRUSION
SHEET FORMING • LAMINATION

***To give you the best** in plastics service, Continental has acquired Reynolds Molded Plastics of Cambridge, Ohio. The facilities of this pioneer organization combined with Continental's extensive resources form a Plastics Division capable of designing, engineering and producing the widest range of plastic products for manufacturers and designers.

Crystal clarity, *plus* chemical resistance ...*in* Plexiglas

PLEXIGLAS valve parts used in the Chem-O-Feeder, designed and built by Proportioneers, Inc., to supply accurately measured quantities of water-treating chemicals to a stream of liquid. Parts are injection molded (by Firestone Rubber & Latex Products Company, Fall River, Mass.) in a single-step operation — molded to final shape and dimensions without subsequent machining.

These outstanding features are among the reasons why Proportioneers, Inc., selected PLEXIGLAS for the valve parts on its widely used chemical feeder:

Resistance to chemicals, especially the solutions used in water treatment.

Lasting transparency, to permit quick visual inspection.

Ease of molding into *finished* parts, complete with assembly threads and flanges.

Dimensional stability and low water absorption.

Add to these advantages such other features as light weight, high impact strength, resistance to weathering, permanent electrical properties...and you may see many ways in which "Aviation's Standard Transparent Plastic" will fit into your own war production — or post-war plans.

For technical assistance in using PLEXIGLAS to best advantage, call our nearest office: Philadelphia, Los Angeles, Detroit, Chicago, Cleveland, New York. Canadian Distributor: Hobbs Glass Ltd., Montreal.

8 awards to Rohm & Haas Company and its associated firms, The Resinous Products & Chemical Company and Charles Lennig & Company.

Only Rohm & Haas makes

PLEXIGLAS

CRYSTAL-CLEAR ACRYLIC SHEETS, RODS AND MOLDING POWDERS*

*Formerly CRYSTALITE Molding Powders

PLEXIGLAS is the trade-mark, Reg. U. S. Pat. Off., for the acrylic resin thermoplastic sheets, rods and molding powders manufactured by Rohm & Haas Company.

ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

Manufacturers of Chemicals including Plastics . . Synthetic Insecticides . . Fungicides . . Enzymes . . Chemicals for the Leather, Textile and other Industries

SAV-WAY ANNOUNCES SARA-SEAL

A New Achievement in Flexible Plastic Packaging

SAV-WAY SARA-SEAL, the miraculous new packaging and sealing method machine, automatically encases anything from a ball bearing to a gyro-compass in a moisture proof, air-tight, floating bag of glistening transparent plastic with a *welded* closure. Designed for Saran*, it is now being engineered for use with a wide range of flexible plastic materials.

Today, Sav-Way Sara-Seal is available only to the Armed Forces and their suppliers . . . for the fast, sure packaging of radar equipment, aircraft parts, delicate surgical instruments, precision gages . . . in fact, any critical war material that must arrive at its destination protected from the corrosive action of moist salt air and from dust laden atmosphere.

Tomorrow, Sav-Way Sara-Seal will play an important part in the packaging of countless perishable commodities. Wherever it is desirable to keep moisture either in or out, or to protect natural or manufactured products from contaminating atmosphere, Sav-Way Sara-Seal will find work to do.

If you are faced with a postwar packaging problem, our engineering department will be glad to work with you in adapting Sara-Seal to your specific requirements.

Send for Description and Photographs of the Sara-Seal Machine and Samples of the Sara-Seal Closure

Sav-Way

**Trade Mark Reg. U. S. Pat. Off.*

SAV-WAY INDUSTRIES

MACHINE TOOL DIVISION

BOX 117, HARPER STATION, DETROIT 13, MICHIGAN

"CAN DO"

Here at Mills, every phase of production from drawing board to the finished product, is characterized by the phrase, "can do."

This "can do" is built upon extensive peacetime experience and the versatile "know how" acquired through meeting war's urgent demands.

Recent developments in techniques and materials have revealed new and richer possibilities for thermoplastics. Mills' engineering and creative staffs are using their working knowledge of these technical advances to constantly improve our injection molding and extrusion of thermoplastics.

Your investigation of Mills' "can do" may well provide the profitable answer to your peacetime production problems.

For more detailed information about MILLS PLASTIC* pipe, tubing and fittings, write for circulars containing data and illustrations. Or, write on your letterhead for the new Injection Molded and Extruded Plastics catalog. *Tr. Mark Reg.

ELMER E. MILLS CORPORATION

Molders of Tenite, Lumarith, Plastacele, Fibestos, Lucite, Crystallite, Polystyrene, Styron, Lustron, Loalin, Vinylite, Mills-Plastic, Saran and Other Thermoplastic Materials

153 WEST HURON STREET, CHICAGO 10, ILLINOIS

From The B-29 Bomber To The Kitchen Stove Is A Big Jump! but

Right now your plant, your manufacturing processes, and your Plastics are geared for definite war production . . . they're in a well-worn niche where they fit comfortably and snugly.

But what will happen when you switch to civilian manufacture? Many of your operations . . . much of your machinery . . . and, undoubtedly, your Plastics, themselves, will have to be changed to meet new demands.

And that's where we come in! We have facilities for testing your Plastics, on a physical, chemical, or electrical basis, for any problem of practical application. As a result of our tests you know just what new applications your Plastics are suited for . . . just what changes in product structure are necessary for civilian product requirements.

In addition, we offer the services of our research engineers, chemists, and technicians in surveying your manufacturing set-up and blue-printing new efficiencies for postwar operation.

Write for complete price list of tests.

Member of American Council of Commercial Laboratories

UNITED STATES TESTING COMPANY, INC.

ESTABLISHED 1880

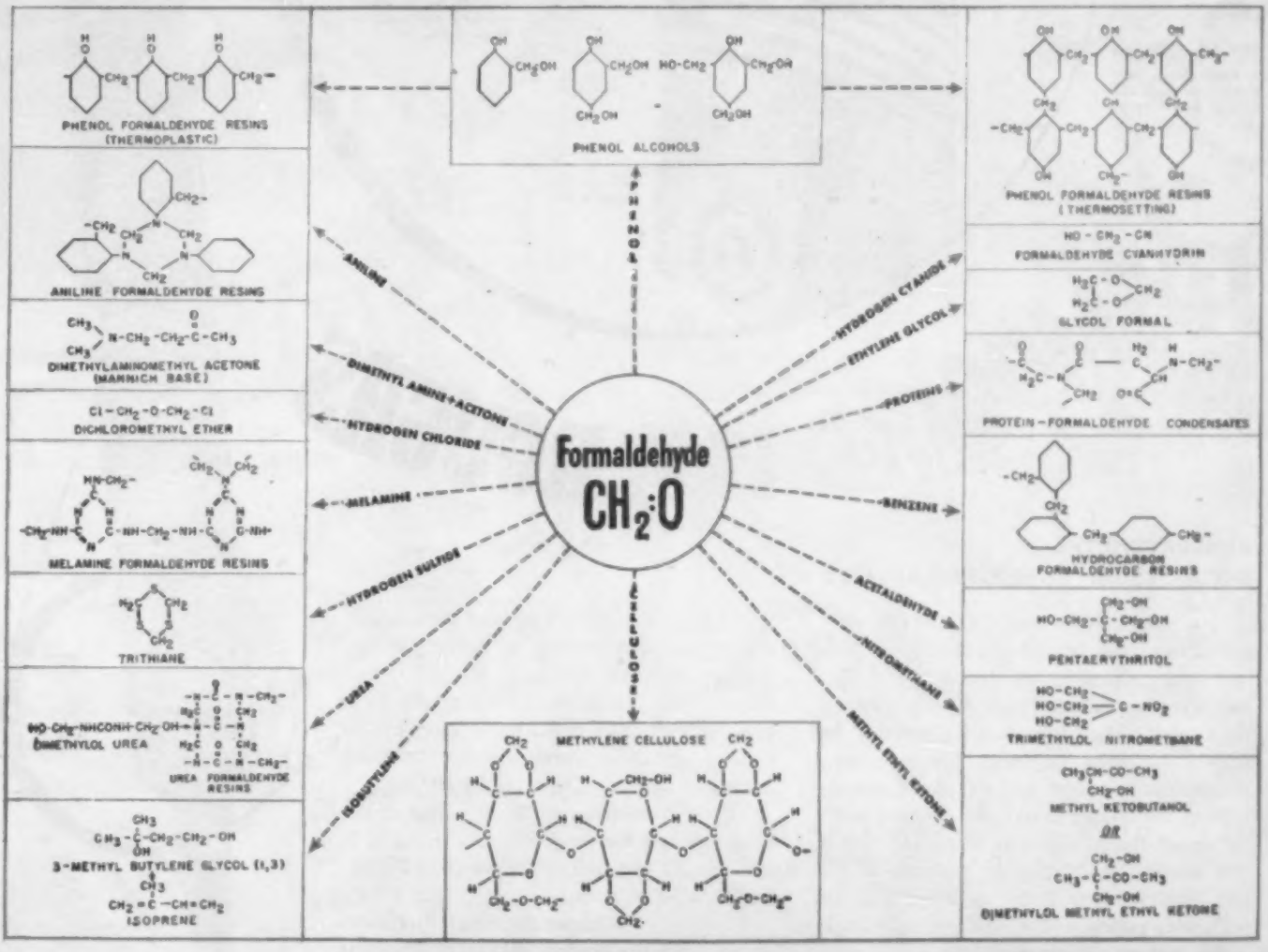
HOBOKEN, NEW JERSEY

PHILADELPHIA, PA. • BOSTON, MASS. • WOONSOCKET, R. I. • CHICAGO, ILL. • NEW YORK, N. Y.

FORMALDEHYDE

FORMALDEHYDE has unique chemical and physical properties. It provides the chemist with a chemical "button," the reactive methylene group CH_2, that links molecules into products with unusual and useful properties. Typical reactions include addition, condensation, reduction, and those involving several types of reactants. These reactions give an indication of the versatility of formaldehyde. For the research chemist and the manufacturer, formaldehyde is a low-priced, extremely reactive product of high purity —a chemical which normally is readily available in practically unlimited quantities.

SOME TYPICAL REACTIONS OF FORMALDEHYDE



Adequate amounts of formaldehyde monthly can be obtained for research and experiment without application to WPB. Information on specific applications and methods of handling formaldehyde are available from the Electrochemicals Department, E. I. du Pont de Nemours & Co. (Inc.), Wilmington 98, Delaware.

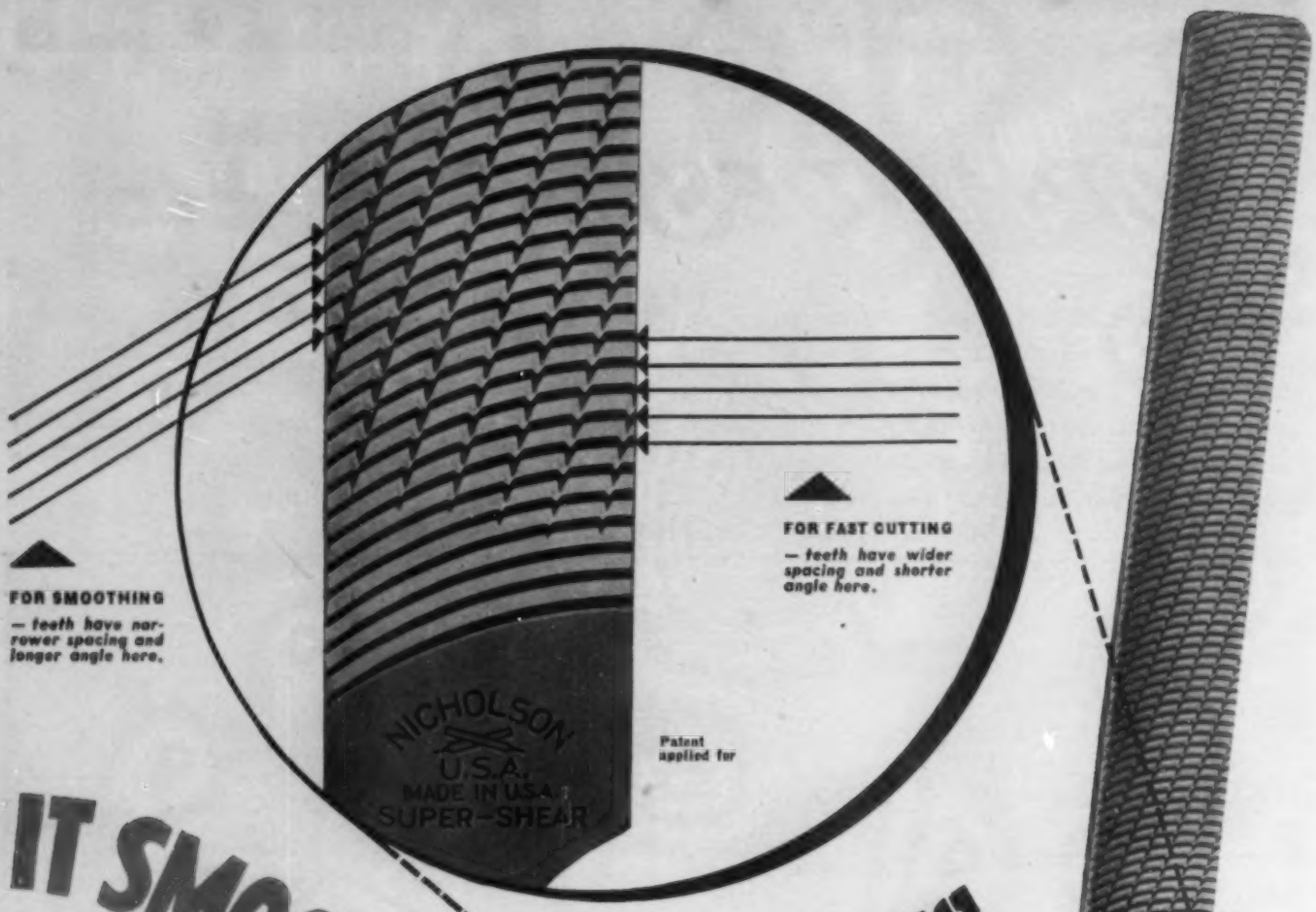
DU PONT ELECTROCHEMICALS

DU PONT

REG. U. S. PAT. OFF.

Your best investment is WAR BONDS!

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*



IT SMOOTHS AS IT ROUGHS

ANNOUNCING THE
NICHOLSON SUPER-SHEAR FILE

. . . a distinctively new "double-purpose" milled tooth file. Ideally suited to filing plastics—especially the softer, "shreddy" types; and where areas are larger or edges longer than usual. (Also practical for working on aluminum, brass, babbitt, bronze, copper, magnesium, cast iron and soft-metal alloys.)

Note the unique design. The curved teeth —"razor"-sharp!—are cut in an arc that is "off center" in relation to the axis of the file. This permits them to begin the cut with wide gullets and virtually a right angle —*for fast stock removal.*

The teeth become shorter and closer together as they terminate in a long, shearing angle—*for producing the finishing effect.*

Thus, when a surface or edge is filed with an overlapping stroke in a right-to-left oblique working direction, the Nicholson Super-Shear "smooths out its tracks as it goes." Practically two files in one! Longitudinal serrations break up the shreds or chips and help the file to clear itself.

The Nicholson Super-Shear is one of the biggest single file developments in years. It is a worthy addition to the range of Nicholson Files for plastics.

For specific recommendations, tell us something about the product you make, the type of material you use, and the filing problems you encounter—and we'll be glad to name *The right file for the job.*

NICHOLSON FILE COMPANY • 44 ACORN STREET • PROVIDENCE 1, R. I., U. S. A.
(Also Canadian Plant, Port Hope, Ont.)

NICHOLSON FILES FOR EVERY PURPOSE NICHOLSON U.S.A. MADE IN U. S. A.

Some **facts**

you should know about

Allymer

Columbia's new *thermosetting*

"contact-pressure" allyl resin monomer

This significant contribution to the plastics field is of especial importance to manufacturers of products where Abrasion Resistance, Strength, Chemical Resistance and Ease of Application are essential. Allymer is now prepared in three basic types, all of which are suitable in varying degrees for either casting or impregnation:

Allymer CR 39—A monomeric liquid of low volatility which, when heated in the presence of a peroxide catalyst, readily solidifies to a hard, insoluble, infusible, glass-clear material. Especially suitable for castings, as it affords an unusually high degree of optical clarity.

Allymer CR 149—A crystalline monomer which gentle warming transforms to a liquid of low volatility. It assumes a structure similar to Allymer CR 39 when heated in the presence of a peroxide catalyst. When used with such laminates as paper, cloth, or Fiberglas, extraordinarily high strengths are obtained.

Allymer 170—A fast-curing liquid monomer, which may be modified in all proportions with Allymer CR 39 or CR 149 . . . the modification of properties being in the direction of those of the Allymer used.

TECHNICAL INFORMATION AND SAMPLES AVAILABLE

If you are seeking a means of improving your products, or widening the scope of your operations, write for Data Sheets. Then, if the properties and characteristics of Allymer indicate potentialities for your business, samples may be obtained for experimental purposes.

COLUMBIA CHEMICALS

PITTSBURGH PLATE GLASS COMPANY
COLUMBIA CHEMICAL DIVISION
GRANT BUILDING · PITTSBURGH 19, PA.

CHICAGO · BOSTON · ST. LOUIS · PITTSBURGH · NEW YORK · CINCINNATI · CLEVELAND · PHILADELPHIA · MINNEAPOLIS · CHARLOTTE

Superiority of PANELYTE* SHOWN IN HARTZITE FAN BLADES

PANELYTE Blades in five Hartzite Fans, as above, in operation since June, 1942, unaffected by atmospheric change or corrosive attack.

PANELYTE Blade (62" long — 14½" across widest section), mass-produced for Hartzell Propeller Fan Co., Piqua, Ohio, being removed from mold . . . one of the largest thermo-setting plastic parts ever produced commercially.

In Corrosion Resistance . . . Light-Weight Strength . . . Long Trouble-Free Service

Since June, 1942, 30 PANELYTE Plastic Fan Blades have been in operation atop a midwest municipal works — without developing corrosion spots or other defects! Outdistancing performance of aluminum or metal-sheathed wood, light-weight PANELYTE (specific gravity only one-half that of aluminum) cuts equipment costs by permitting low starting current urge and, by lessening bearing loads.

Low coefficient of friction prevents roughening of blade surface, while greater internal damping reduces noise. Precision molding makes blades interchangeable . . . saves production time and expense.

PANELYTE engineers are ready to work with you in the application of paper, fabric, wood veneer, fibre glass and asbestos base thermo-setting laminated plastics, and to discuss the mass production of intricate fabricated and molded parts.

Write for factual "Data Book"

PANELYTE *the structural plastic*

PANELYTE DIVISION
ST. REGIS PAPER COMPANY
230 PARK AVENUE
NEW YORK 17, N. Y.

Sales Offices: Atlanta, Boston, Chicago, Cincinnati, Cleveland, Dallas, Denver, Detroit, Kansas City, Los Angeles, Mexico City, Montreal, New Orleans, Phoenix, St. Louis, St. Paul, San Francisco, Seattle, Syracuse, Toronto, Trenton, Vancouver

* MASS PRODUCTION OF SHEETS, RODS, TUBES, MOLDED FORMS, FABRICATED PARTS

HYCON

High Pressure with Increased Capacity

Adaptation of aviation-type pumps for industry

Motor mounted... 3000 p.s.i.... 2.25 G.P.M.

Constant volume or integral pressure control

•

These higher capacity pumps now available

•

Specifications and Engineering Data on Request

THE NEW YORK AIR BRAKE COMPANY

Hydraulic Division

420 LEXINGTON AVENUE, NEW YORK 17, N. Y. • FACTORIES: WATERTOWN, N. Y.

CASE HISTORIES PROVING THE POWER OF THE PRESS

LAKE ERIE IS READY FOR THE PLASTICS AGE

LAKE ERIE self-contained, semi-automatic hydraulic presses offer many new developments for all types of plastic molding.

Illustrated are two of these latest presses of sixty tons capacity; 18″ x 16″ platens; 12″ stroke. These units have complete time cycle and full automatic push-button control, including adjustable plasticizing and breathing stroke.

Lake Erie is ready for the "plastics age". We can adapt standard presses to your compression molding needs or build special presses to your specific requirements. Write for information.

LAKE ERIE
ENGINEERING CORP.
BUFFALO, N.Y. U.S.A.

LAKE ERIE ENGINEERING CORPORATION
868 Kenmore Station, Buffalo 17, N. Y., *Offices in Principal Cities*

Plastic electric control grips, designed, molded and assembled by Plastic Manufacturers, Inc. for Sperry Gyroscope Company. *They typify a wide range of war products that suggest peacetime applications.*

When LIFE DEPENDS ON S-P-E-E-D!

No one has higher regard for the 60th part of a minute than the turret gunner in a military plane.

These molded plastic gun grips reduce time-consuming motions for him by providing fingertip control over a variety of tasks. Multiple switches incorporated in each grip permit the gunner to

- operate sighting mechanism of the turret . . .
- fire a pair of machine guns . . .
- maintain communication with crew members . . .

An automatic safety switch prevents unintentional firing of the guns.

The plastic material used has dielectric properties which make insulation of switches unnecessary and prevent short circuits. It is outstandingly good for extreme high and low temperatures. Grips have high impact qualities and durable finish, are light in weight and have a "comfortable feel".

Engineering "know how", molding experience and modern facilities enable us to produce and *completely assemble* precision parts and products in volume for military needs. Perhaps this combination can provide solution for some of your product problems—now and post-war.

PM TRADE MARK

Send for a copy of Folder File MP1, outlining our plastic services.

PLASTIC MANUFACTURERS

INCORPORATED

STAMFORD, CONNECTICUT

MOLD MAKING • INJECTION & TRANSFER MOLDING • COMPLETE ASSEMBLY

Representatives: DETROIT 2—805-06 New Center Bldg. • LOS ANGELES 35—1440 So. Robertson Blvd.

CANADA—A. & M. Accessories Ltd., 19 Melinda Street, Toronto; 1405 Bishop Street, Montreal; 920 Second Avenue, Seattle

Experience Proves

That preheater electrodes MUST BE...

1. Conveniently located...
2. Easy to load and unload
3. Automatically adjustable to preform size...
4. Provided with positive air-gap adjustment

Ready for Loading...
Upper electrode is fully raised and retracted, completely exposing lower electrode.

Typical Load...
Two *flat* preforms, each 1½" thick and 6" in diameter, are uniformly heated in this set-up.

Special Load...
Domed preforms, placed on edge in dual curved lower electrodes, are uniformly heated in this set-up.

Only in

AIRTRONICS Preheaters are these requirements fully met

For simplicity and speed of operation, AIRTRONICS, alone, brings these *four* important design features to the plastics molding industry. Operational experience proves that the combination of these features has contributed greatly to the output of molding plants —from coast to coast.

Electrodes visible and accessible
Height and position of electrodes minimizes operator motion during preheating operation. Preforms are visible at all times.

Upper electrode retracts when elevated
Full exposure of lower electrode, for easy loading and unloading, results from complete retraction of upper one. Electrode dimensions permit optimum arrangement of conventional preforms.

Self-aligning feature accommodates preform loads up to 3" high
No electrode adjustments are required when changing the run from wafer-thin preforms to ones that are 3" high. An ingenious linkage automatically keeps the electrodes parallel to each other—at all times.

Vernier-screw air-gap adjustment
When an air-gap between the load and upper electrode is necessary, it is simply and positively made with two thumb screws. Once adjusted they maintain the desired air-gap for the duration of the run.

Special electrodes available
Should your preforms require curved or especially shaped electrodes, AIRTRONICS engineers will design special ones to insure uniform preform heating.

Write for complete data, addressing inquiries to Dept. MP.

Airtronics MANUFACTURING CO.

CHICAGO	NEW YORK	LOS ANGELES
121 W Wacker Drive	31-28 Queens Blvd.	5245 W. San Fernando Rd.
Zone 1	Long Island City, Zone 1	Zone 26

"Hey Fellow, I'm no racehorse"

Race-horse *lightness* with truck-horse *strength*? Nature isn't asked to produce such "don't-go-together" combinations. But KYS-ITE is—and does. Knowing that, engineers turn our way when plans call for one material combining *all* the properties shown below. Look them over and see how KYS-ITE fits into your production picture, too.

GREAT STRENGTH WITH LIGHT WEIGHT

Preformed before curing, an even distribution of phenolic resin on interlocking fibres results in great tensile and compressive strength with an impact strength 4 to 5 times that of ordinary plastics.

WIDE RANGE OF SHAPES

Complicated pieces with projections and depressions, large or small shapes and sections—all these and more, too, are molded successfully in KYS-ITE.

KYS-ITE CAN "TAKE IT"

Unusually durable and resistant to abrasion, impervious to mild alkali and acid solutions.

INTEGRAL COLOR AND FINISH

Lustrous finish and beautiful colors are part of the material itself, hence KYS-ITE is permanently attractive. A wipe and it's bright!

NON-CONDUCTOR

KYS-ITE's dielectric properties make it invaluable where safety is a factor. Also a non-conductor of heat. Non-resonant and non-reverberating.

WHAT CAN KYS-ITE DO FOR YOU?

Ours is a complete service. We mold to specifications, the article reaching you in finished form. We invite your inquiries, will gladly discuss any problem on plastics. If KYS-ITE isn't the solution, we'll suggest other possibilities. Production now being scheduled as orders arrive. May we hear from you soon?

Buy War Bonds—and Keep Them

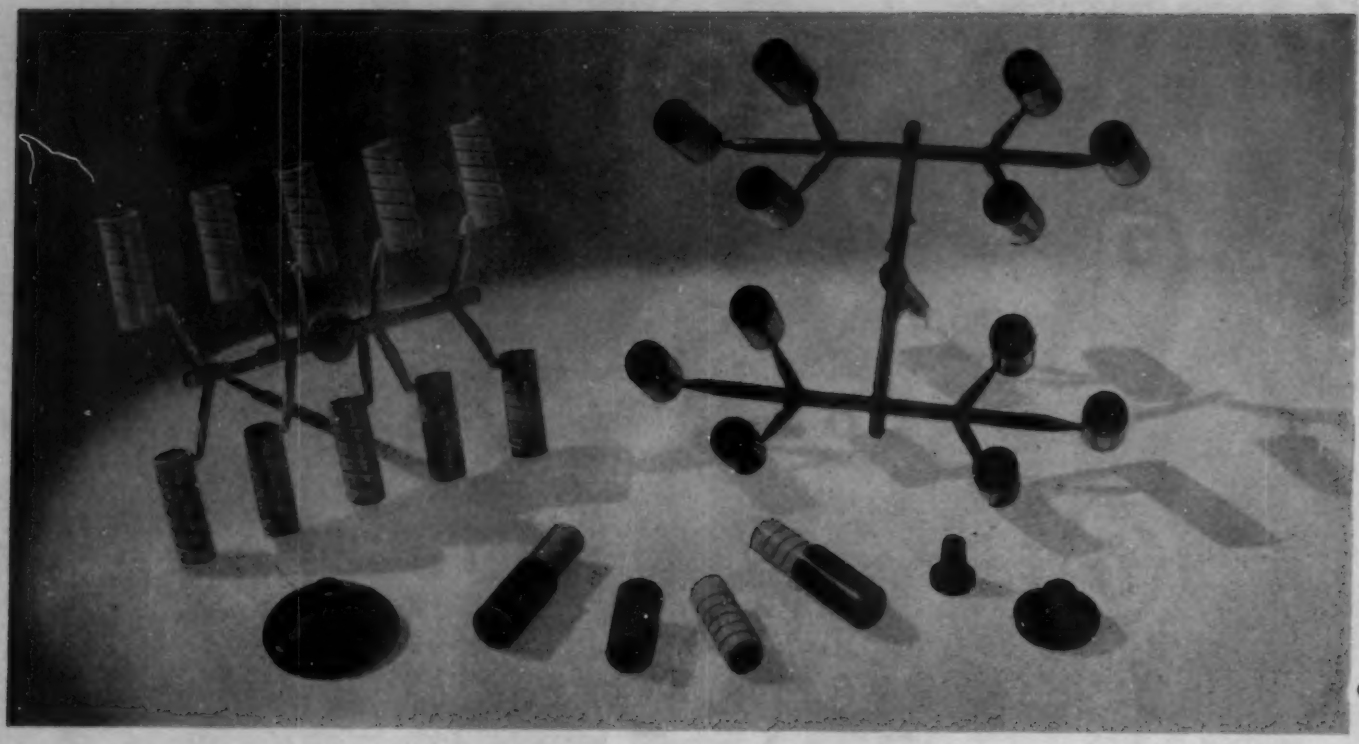
KEYES FIBRE COMPANY
420 Lexington Avenue
New York 17, New York
Plant at Waterville, Maine

KEYES
MOLDED PRODUCTS

KYS-ITE articles indicating the range of items we mold to specifications and deliver complete, ready for use.

The Long-Fibred Wood Pulp Filled Phenolic KYS-ITE Resin Plastic Pre-formed Before Curing

Trademark Reg. U. S. Pat. Off.



EXTRUSION *and* INJECTION MOLDING

THREADS ... RODS ... TUBES ... SHEETS and other FORMS
SIMPLE, INTRICATE or COMPLEX PARTS or INDIVIDUAL ITEMS

EXTRUSION molding in continuous lengths, flexible or rigid in all types of thermoplastics.

INJECTION molding from expert designing of molds to sustained standards of production and quality.

A competent Engineering and Technical Staff at your Service!

CELLUPLASTIC ORP.

CELLUPLASTIC CORPORATION

44 AVENUE L NEWARK, N. J.

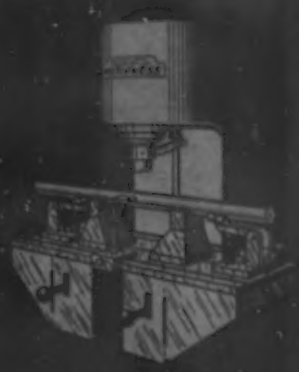
WEST COAST REPRESENTATIVES: CONTAINER SERVICE CO., 1266 North Western Avenue, Los Angeles 27, Cal.

INDUSTRY'S NEW TOOL OF MULTIPLE USES

A Four-ton giant in midget form!

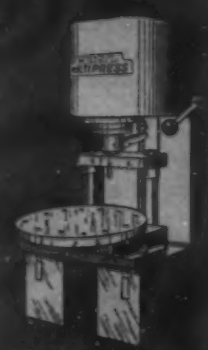
MULTIPRESS

MULTIPRESS is a *new kind* of machine tool! Compact, streamlined, completely self-contained, this bench-size oil-hydraulic "work horse" packs up to 4 tons of accurately controlled power, and adapts that power to an amazingly wide range of operations. Standard fixtures and accessories extend its applications to almost every type of work calling for *pressure*—sustained or in repeat strokes . . . in single or automatically repeated cycles . . . synchronized with indexing tables or other feed mechanisms. The basic unit alone, without any of its many accessories, delivers downward ram pressures of from 300 to 8000 pounds . . . upward pressures to 5000 pounds . . . strokes of from 1/16 inch to 6 inches . . . ram speeds up to 200 inches per minute downward, or 300 upward. Work table measures 10 1/2 x 16 inches. Opening between ram and work table is 11 inches. Write today for complete details on MULTIPRESS, the NEW tool of Industry's Right Hand.

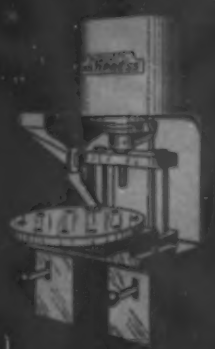


With Straightening Fixtures

With Broaching Attachment

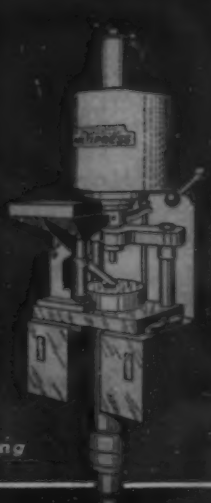


Showing Dial-Type Feed



With Hopper and Dial-Type Feed

With Motor Driven Indexing Table



Equipped for Automatic Pelleting

With Honing Fixtures

Basic Unit
$575.00

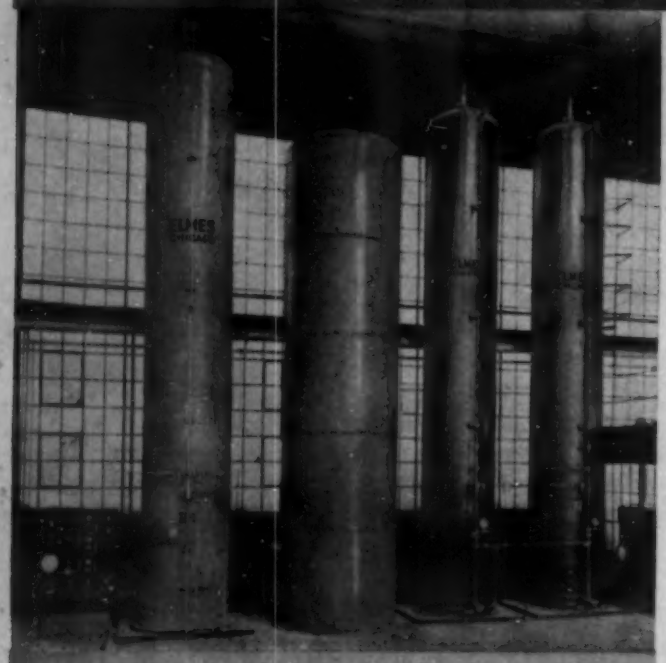
Patents Applied For

The DENISON Engineering Co.
1176 Dublin Road Columbus 16, Ohio

INDUSTRY'S RIGHT HAND

DENISON EQUIPMENT for APPLIED HydrOILics

How to Maintain a Constant Power Supply for HYDRAULIC EQUIPMENT That will "Step-up" Production and Lower Costs



ELMES PISTONLESS-TYPE, AIR-BALLASTED, HYDRAULIC ACCUMULATOR

Patented. Modern, efficient, reliable . . . requires minimum floor space, no special foundation. Foolproof design and construction give a constant flow of power, always.

THE Elmes pistonless-type, air-ballasted accumulator is today's most efficient method of storing liquid under pressure; and, within specific predetermined pressure limits, it gives a constant power supply. The effectiveness of this unit is the result of over 50 years' experience in the design and construction of accumulators. As a result, Elmes installations in scores of the leading plants of the U. S. and Canada are today rendering uninterrupted service. These are the advantages an Elmes air-ballasted accumulator will bring to you:

ELIMINATES LINE SHOCKS! The compressed air, used to maintain pressure on the column of liquid, serves as a shock absorber and thus eliminates line shocks.

CLOSER PRESSURE REGULATION! The pressure variation from the high to low point of the liquid column is definitely controllable by the volume in the air chamber.

SAVES FLOOR SPACE! Because pressure vessels are not large in diameter and since no large ballast tank or platform is required, there is a definite saving in floor space.

NO INTERNAL MOVING PARTS OR PACKINGS! There are no pistons or internal moving parts to be maintained because compressed air acts directly on the column of liquid.

EASY TO INSTALL! Elmes air-ballasted accumulator requires no special, heavy foundation. Pressure vessel, or vessels, are quickly and easily set in place on the ordinary factory floor.

VARIABLE PRESSURE ACCUMULATORS are also available with pressure changes attained by simple fingertip controls.

Consult the Elmes Engineering Staff for a solution to any hydraulic power problem with which you are confronted. Or, write for a FREE copy of this late bulletin on accumulators. It describes their design, construction, safety features, electrical controls, etc.

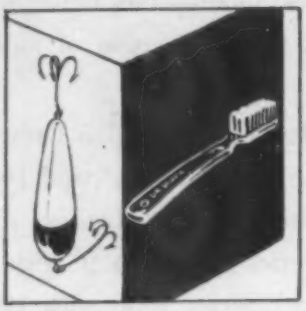
ELMES ENGINEERING WORKS *of* AMERICAN STEEL FOUNDRIES, 225 N. Morgan St., Chicago 7, Illinois

ELMES HYDRAULIC EQUIPMENT

Also Manufactured in Canada

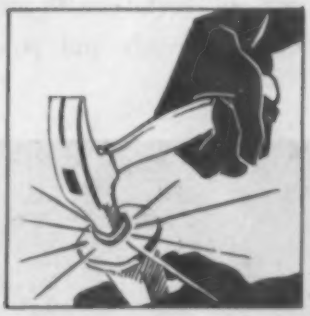
METAL-WORKING PRESSES · PLASTIC-MOLDING PRESSES · EXTRUSION PRESSES · PUMPS · ACCUMULATORS · VALVES · ACCESSORIES

Chemaco's BIG 4 IN MOLDING POWDERS



WHEN YOU WANT VERSATILITY

choose **Chemaco Cellulose Acetate**—a colorful, adaptable plastic with exceptional toughness and impact strength. Chemaco Cellulose Acetate comes in a brilliant crystal and an unlimited range of transparent, translucent and opaque colors. Notable for its resiliency and moldability, Chemaco Cellulose Acetate is suitable for many plastics applications — from toothbrushes to fishing floats and lures.

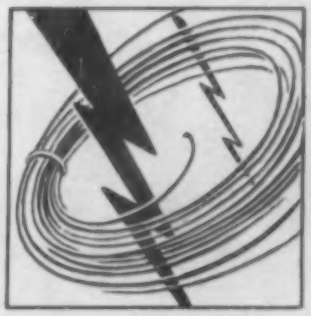


WHEN YOU WANT IMPACT STRENGTH

choose **Chemaco Ethyl Cellulose**— the toughest and strongest of all cellulose plastics. Chemaco Ethyl Cellulose is capable of withstanding impact at extremely low temperatures. It is available in colors. Suggested uses embrace flashlight cases, tool handles, hammer heads, extruded trim and hardware, automotive and aircraft parts.

WHEN YOU WANT CHEMICAL RESISTANCE

choose **Chemaco Polystyrene**— a thermoplastic with exceptional resistance to acids, alkalis, glycols, aliphatic hydrocarbons and most alcohols. It has excellent dielectric strength, low water absorption and unusual dimensional stability. The low specific gravity and its thermoplastic qualities make it extremely economical. The molder can obtain more pieces per pound and utilize all rejects, gates and sprues. It is highly successful for closures, cosmetic cases, laboratory equipment and electrical devices.



WHEN YOU WANT DIELECTRIC STRENGTH

and FLEXIBILITY choose **Chemaco Vinyl Compounds.** These elastomeric plastics have exceptional dielectric strength, are non-flammable and self-extinguishing and highly resistant to water, chemicals, oxidation and abrasion. Their resistance to weather makes them desirable for tubing, conduits, jacketing for coaxial cables and storage battery separators.

Chemaco Corporation

(A subsidiary of Manufacturers Chemical Corporation)

Berkeley Heights, N. J.

Branch Office—Cleveland, O. Representatives—Machinery Sales Company, Los Angeles • San Francisco

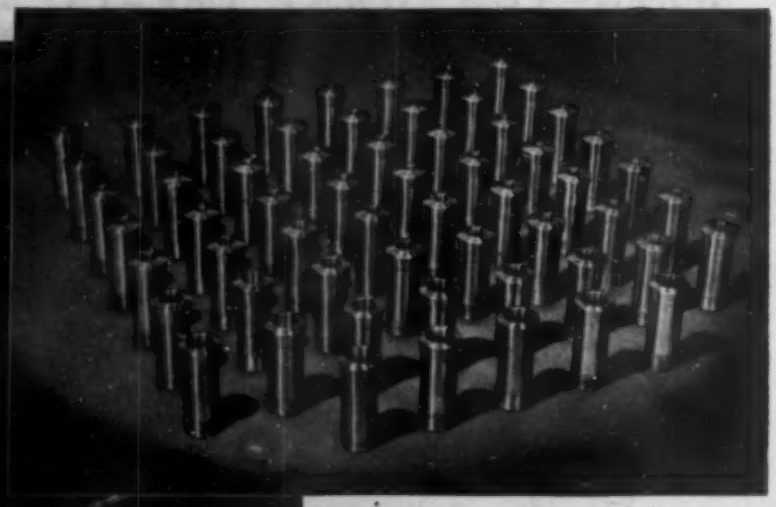
Versatility
for Precision Toolroom Work

The ease with which South Bend Toolroom Lathes can be changed from one set-up to another for an almost unlimited variety of precision operations is one of the reasons for their popularity in the busy toolrooms of war-rushed essential industries.

Convenient, well placed controls; easy reading graduated dials; and smooth operation save time and reduce operator fatigue to a minimum. A wide range of spindle speeds permits machining various kinds of metals with maximum cutting tool efficiency. Threads and power feeds for all requirements are instantly available through a full quick change gear mechanism.

A complete line of attachments and accessories simplifies tooling the lathe for many special and unusual classes of toolroom work.

South Bend Toolroom Lathes and Engine Lathes are made in five sizes: 9″, 10″, 13″, 14½″, and 16″ swing respectively. Precision Turret Lathes are available in two sizes: Series 900 with 9″ swing and ½″ collet capacity and Series 1000 with 10″ swing and 1″ collet capacity. Write for catalog.



COLLETS

Collets for all sizes and types of South Bend Lathes are now being shipped directly from stock. All sizes from 1/16″ to 1″ diameter in steps of 1/64″ are available.

A complete set of collets is especially helpful in toolroom and maintenance work. Often the time saved by having on hand the right size collet for a single rush job will more than compensate for the cost of a full set of these fine collets.

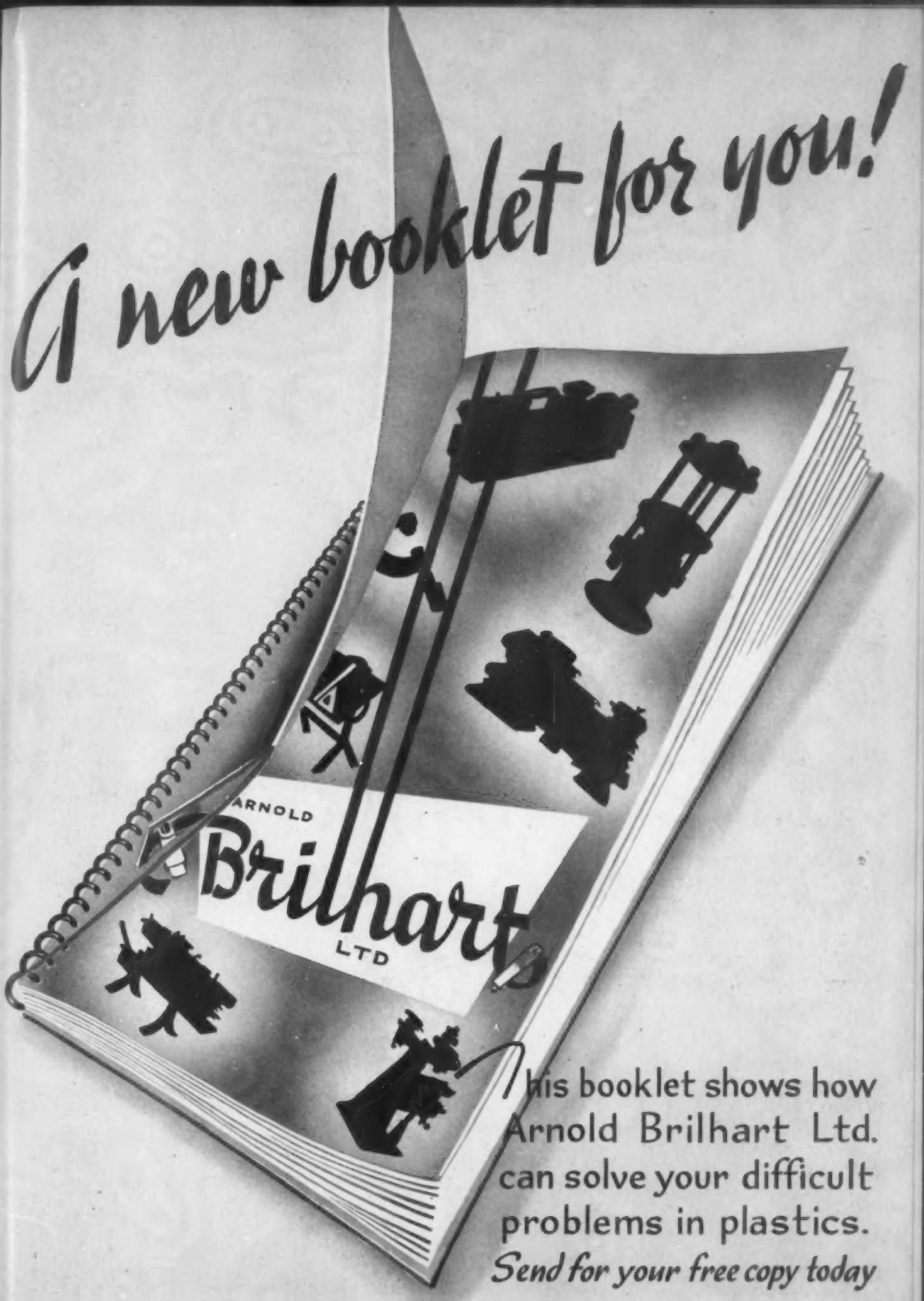
Check your collet requirements today—for toolroom, maintenance, and production work—and order all you need. Specify size and serial number of lathe.

Buy War Bonds—Save For Lathes

SOUTH BEND LATHE WORKS

449 E. MADISON STREET • *LATHE BUILDERS FOR 38 YEARS* • SOUTH BEND 22, IND.

A new booklet for you!



This booklet shows how Arnold Brilhart Ltd. can solve your difficult problems in plastics.

Send for your free copy today

ARNOLD BRILHART LTD. 435 MIDDLENECK RD • GREAT NECK, N.Y. • *Phone:* GREAT NECK 4054

A SIMPLE STATEMENT OF FACT

We are molders.

We mold plastics.

We mold all commercial plastics for all industries.

We have been doing this for a number of years.

We have learned a lot about plastics.

We have also made a good living at it.

We have also put a lot of money back into our plant.

Frankly, we get as much kick out of a good plant as we do out of making money.

There is a lot to this plastics game that it takes a long time to learn.

We are still learning.

Our plant, our experience are at your service to mold plastics for your company.

As custom molders it is our business to make your problems our problems —for a profit, of course.

If you want the facts about plastics, we have prepared a little book to help you. It is called "A Ready Reference For Plastics" and you may have a copy without charge, if you are a business man or a Government employee. A note on your letterhead will do.

BMCB

ARMY E NAVY

SPI MEMBER SOCIETY OF THE PLASTICS INDUSTRY

BOONTON MOLDING COMPANY

MOLDERS OF PLASTICS · PHENOLICS · UREAS · THERMO PLASTICS

BOONTON · NEW JERSEY · Tel. Boonton 8-2020

NEW YORK OFFICE

Chanin Bldg., 122 East 42nd Street, New York 17, N. Y., MUrray Hill 6-8540

WHETHER YOU ARE PROCESSING SYNTHETIC RUBBERS, OR PYROXYLIN PLASTICS OR EXPLOSIVES . . . OR EXPLODING PROCESSING THEORIES..

F/B There are MILLS to suit your needs exactly

Photo Courtesy Firestone T. & R. Co.
Warming rubber tire tread stock.

If it is a job for a mill, we will build a mill for the job.

This is nothing new. We have long made it a practice to ask each purchaser to tell us what he wants to accomplish so that we can furnish a mill to suit his individual requirements. The result may be a standard machine, a modification of a standard mill or a new design throughout, depending on the job to be done.

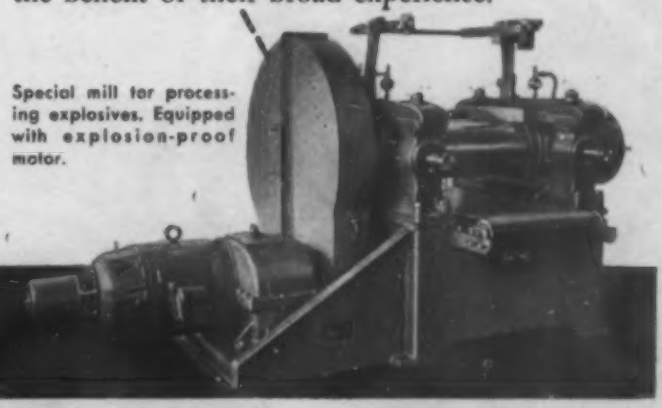
8"x16" Plastics Mill for laboratory use.

In a great many instances the mill supplied is a "standard" machine with but minor modifications and a few special attachments—because, in a long lifetime, we have built mills for almost every conceivable application. Among these are mills for processing natural and synthetic rubber, cellulose compounds, pyroxylin plastics, synthetic resins, caseins, shellac compounds, Bakelite, celluloid, explosives, abrasives, linoleum and phonograph record stocks.

Before you decide on a mill—for either laboratory or production use—we suggest you ask our engineers for recommendations and obtain the benefit of their broad experience.

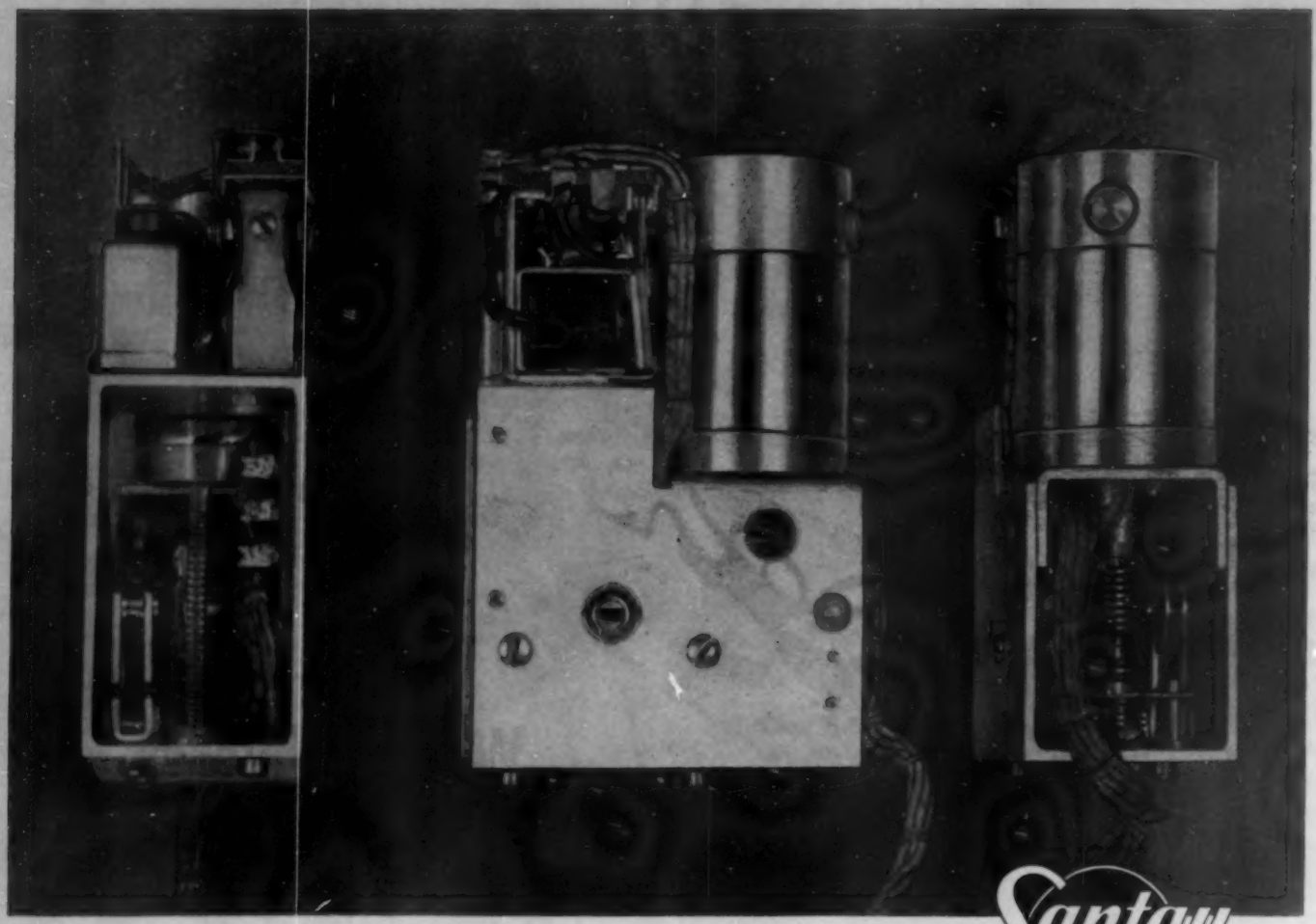
FARREL-BIRMINGHAM COMPANY, INC., ANSONIA, CONN.
Sales Offices: Ansonia, Buffalo, New York, Pittsburgh, Akron, Los Angeles
Plants: Ansonia and Derby, Conn., Buffalo, N. Y.

Special mill for processing explosives. Equipped with explosion-proof motor.



Farrel-Birmingham


INJECTION MOULDING
EXTRUSION MOULDING
PLASTICS
St. Louis
Plastic Parts of Every Description
ST. LOUIS PLASTIC
MOULDING COMPANY
SAINT LOUIS
MISSOURI
DIES AND TOOLS
PLASTIC FABRICATION
PIPE SARAN TUBING
MOULDED PARTS



Santay

SYMBOL OF PRECISION CRAFTSMANSHIP

213 COMPONENT PARTS ARE INCLUDED IN THIS ONE SMALL ELECTRICAL ASSEMBLY

The electro-mechanical assemblies we make are seldom simple. This one, for instance .. a Band Change Selector Mechanism . . *has 213 component parts!* They are manufactured with Santay's precision — tolerances so close that when assembly is complete the unit functions with utmost efficiency. Details concerning this vital war work are, of course, unavailable. It does however serve to emphasize the unusual skill and experience of the Santay engineering staff. Keep this remarkable talent in mind when presented with a production problem in which an intricate electro-mechanical assembly, thermoplastic molding, or metal stamping is involved.

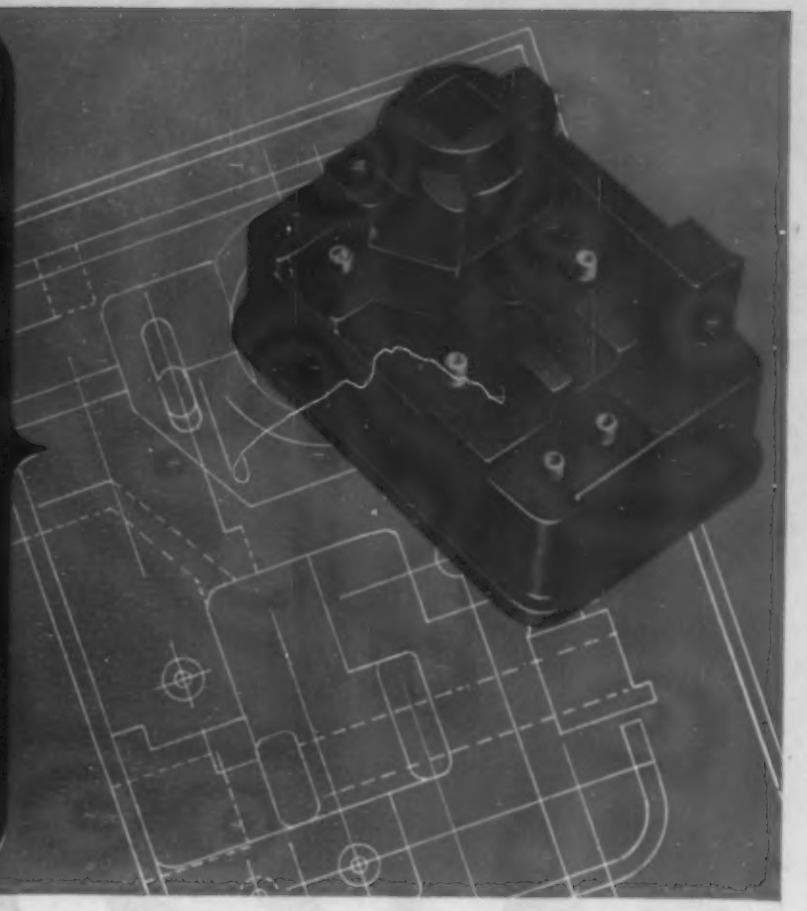
INJECTION MOLDING • METAL STAMPING • ELECTRO-MECHANICAL ASSEMBLIES

SANTAY CORPORATION 351-359 N. CRAWFORD AVE., CHICAGO 24, ILLINOIS

FORMERLY SINKO TOOL & MANUFACTURING CO.

REPRESENTATIVES: POTTER & DUGAN, INC., 29 WILKESON STREET, BUFFALO 2, NEW YORK • PAUL SEILER, 7779 CORTLAND AVENUE, DETROIT 4, MICHIGAN • QUEISSER BROS., 108 E. NINTH STREET, INDIANAPOLIS 2, INDIANA

WE READ BETWEEN THE BLUEPRINT LINES



PLASTIC MOLDERS can look at a prospective job from two angles. They can take the blueprint you supply, figure their methods, materials, costs and deliveries exactly as indicated. That is, they can read just the lines on the blueprints.

AT GENERAL INDUSTRIES, we do more. Naturally, you know the functions of the plastic part better than we do, so we don't attempt any major design changes. *But we do know plastics,* and from our wide experience can make suggestions which come from reading between the lines of the blueprint.

QUITE OFTEN, our customers have found that our ideas result in a product improved in utility or appearance, delivered quicker and at a lower final cost.

THIS METHOD calls for wide experience in the plastic industry. It requires a real knowledge of mold making and of the characteristics of the many different plastic compounds. And, of course, it must be backed up by modern equipment and operators who know their jobs.

SO, when you are thinking of postwar plastic parts, we suggest that you ask us to "read between the blueprint lines." Right now, we're 100% on war work, but when that job is done, we'll have engineers and facilities to take on your peacetime plastic molding. We'd like to have you call on us.

ARMY E NAVY

THE GENERAL INDUSTRIES COMPANY

MOLDED PLASTICS

Molded Plastics Division • Elyria, Ohio

Chicago: Phone Central 8431
Detroit: Phone Madison 2146
Milwaukee: Phone Daly 8818
Philadelphia: Phone Camden 2215

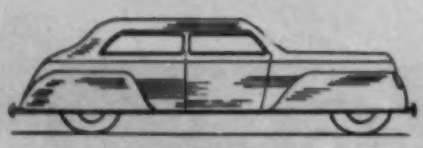
LOOKING AHEAD With RIEGEL-X

This viewing hood for protection at sea against all weather is one of the recent applications of Riegel-X — already firmly established in many industries.

Looking ahead, it will be refrigerators, automobiles, furniture, pre-fabricated homes, boats, and probably certain functional parts of your product too.

For Riegel-X Plastic Laminates are primarily functional. They contribute a new design material that gives light-weight strength, higher insulation, increased dielectric properties, fire resistance, precise fabrication and many other basic qualities.

Unless you have an acceptable end use, our mills cannot help you now. But our engineers can — with a wealth of experience that is yours for the asking. Write to Riegel Paper Corporation, 342 Madison Avenue, New York 17, N. Y.



FOR INSTANCE

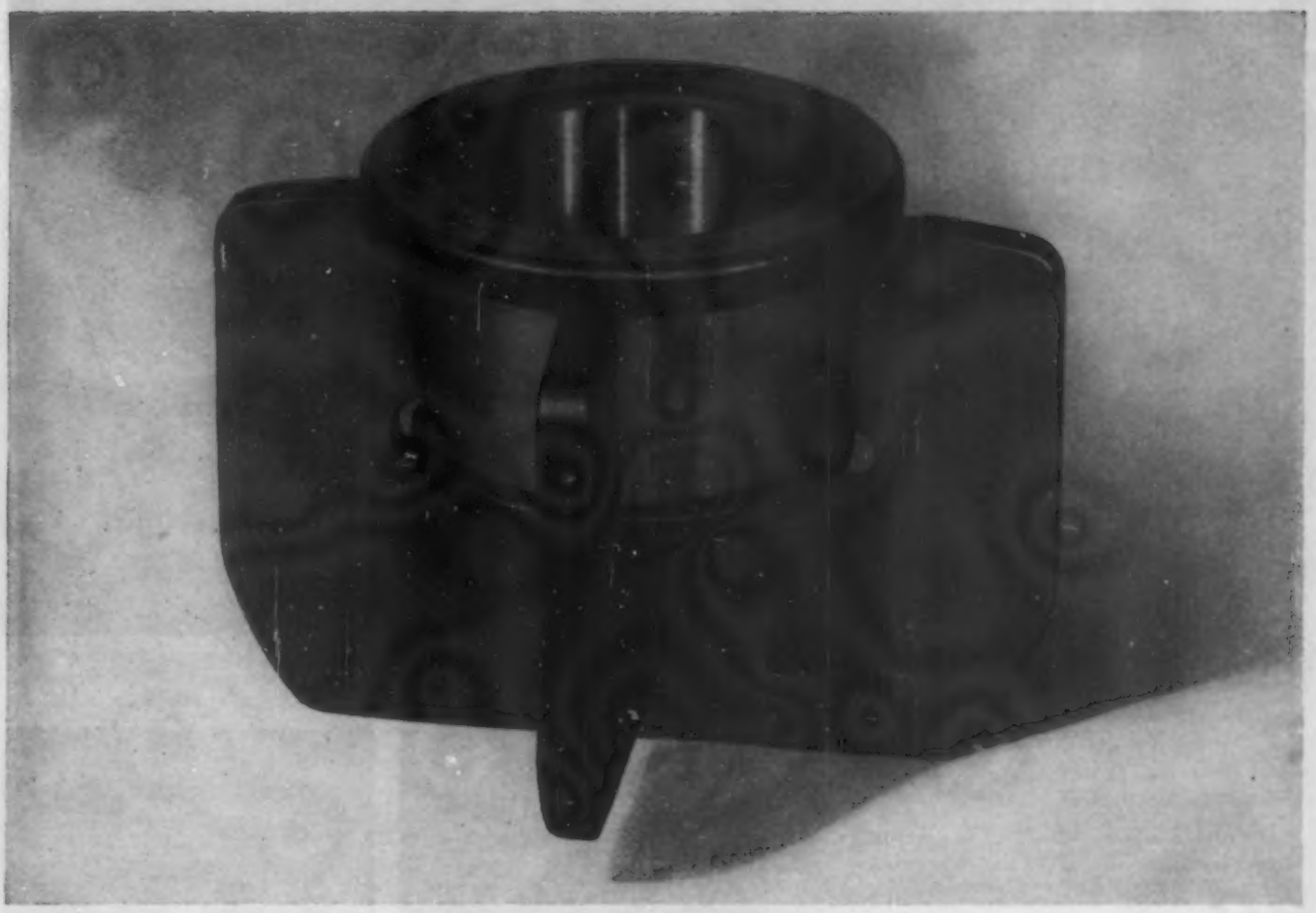
Auto manufacturers are now experimenting with Riegel-X in the construction of auto bodies.

RIEGEL-X

X A group of plain and impregnated base papers for both fluid and direct pressure plastic laminates. X

135


Better COMPRESSION AND TRANSFER MOLDING
★ with
★ automatic
★ controls
☆ In making your postwar plans for plastic parts, get in touch with INTERNATIONAL now.
We particularly like production of knobs, handles, pointers, switch cases, and the like. With increased capacity we can handle more production with greater speed and precision. We are also ideally equipped to manufacture small parts on automatic machines. Write us about your needs. We might have a suggestion to offer.
IMP
INTERNATIONAL MOLDED PLASTICS, INC.
4387 WEST 35TH STREET • CLEVELAND 9, OHIO



Proven correct

BY A GAUGE MADE OF GRAPH-MO STEEL

The accuracy of gauges, used to assure the unerring precision of Timken Roller Bearings, is confirmed by master standards that are held to tolerances of .00005".

But for gauges to be accurate, they must be made from steel that has a minimum of growth and one that will not be unduly distorted by heat treatment.

Graph-Mo Steel has those qualities.

At the end of one year master gauges made from Graph-Mo remained stable and accurate. In the same period similar gauges made of *high grade steel* had a growth of .001". Also gauges of this fine Graphitic Steel showed practically no movement after heat treating.

In addition, Graph-Mo has superior machinability, excellent non-seizing properties, good resistance to wear and abrasion, high response to heat treatment and it grinds easily.

Use this impressive list of qualities to assure the accuracy of your own fine products. Steel and Tube Division, The Timken Roller Bearing Company, Canton 6, Ohio.

A request on your firm's letterhead will bring a 48-page booklet that contains complete data on the five Graphitic Steels.

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
GRAPHITIC STEELS

DOUGLAS AIRCRAFT *Steps Ahead*
WITH FIBERGLAS*-REINFORCED PLASTICS

In jigs, dies and fixtures, plastics are modifying long-established patterns of thinking and ways of doing things.

Douglas Aircraft Engineers, working with the fast-developing techniques of low-pressure laminating, the remarkable new contact pressure resins and with Fiberglas Cloth reinforcement, have taken a revolutionary step from metals to plastics.

The jig shown here, with progress pictures of its manufacture, was fabricated from Fiberglas-reinforced laminated material. Result—the high cost of manufacturing metal tools was reduced. Costly, time-consuming machining was avoided.

The advantages which Fiberglas-reinforced laminates bring to an operation of this kind are lightness, rigidity, dimensional stability, high impact strength and ease of fabrication. And these desirable qualities can be traced back to some of the inherent properties of Fiberglas . . . glass in fiber form.

The Fiberglas fibers have a specific tensile strength beyond that of steel. Because they are inorganic and noncellular, they will not absorb moisture, will not shrink, swell, rot or decay. Therefore, they make ideal textile fibers for specific purposes. Twisted into yarns, woven into cloth and put into plastic laminates as structural reinforcement, they produce finished materials with the advantages which Douglas and a host of other fabricators are so skillfully utilizing.

Fiberglas Corporation does not manufacture resins or finished laminates. However, if you are working with or contemplating using plastics laminates you will want complete information on Fiberglas Cloth. It is yours for the asking. Write *Owens-Corning Fiberglas Corporation, 1876 Nicholas Building, Toledo 1, Ohio. In Canada, Fiberglas Canada Ltd., Oshawa, Ontario.*

The male mold is placed on a corrugated metal table with an air valve for producing vacuum.

The desired number of layers of resin-saturated Fiberglas Cloth are applied to the mold one after another.

A rubber blanket is stretched over the mold and hermetically-sealed at the edges to form a vacuum bag.

Air is evacuated. The table is then rolled into the oven to complete the polymerization of the resin.

Photos courtesy: Douglas Aircraft Co., Inc.

The completed jig.

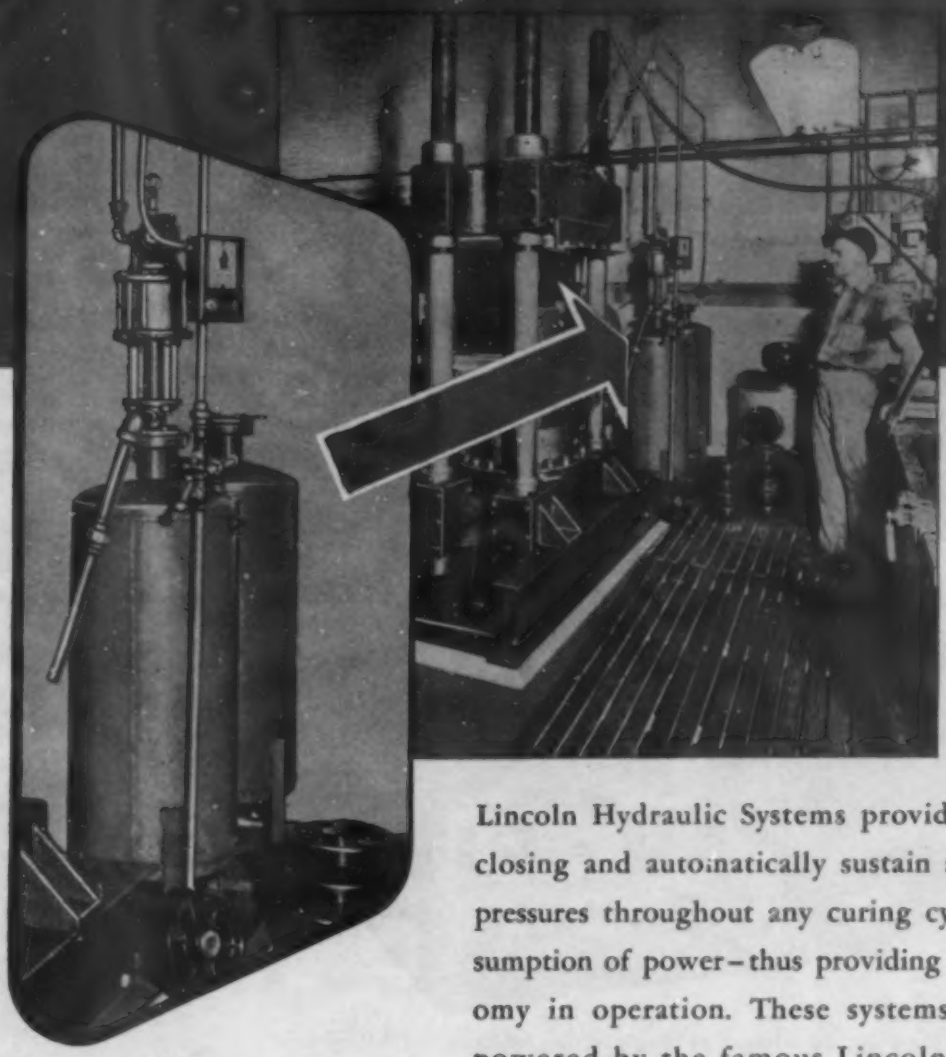
FIBERGLAS..A BASIC MATERIAL

*T. M. Reg. U. S. Pat. Off.

LINCOLN HYDRAULIC SYSTEMS

for

HYDRAULIC PRESSES



Illustrated at left is a Lincoln Hydraulic System operating an H. P. M. 18" Diameter Ram press—molding Phenolic Resin industrial truck wheels.

Lincoln Hydraulic Systems provide rapid daylight closing and automatically sustain selected molding pressures throughout any curing cycle without consumption of power—thus providing exceptional economy in operation. These systems are powered by the famous Lincoln Air Motor which has long proven its reliability and efficiency in many industrial applications and under the most adverse operating conditions.

H44-1

Hydraulic System Selection

Recommendations of the proper Lincoln System will be made by our Engineers upon receipt of the following information . . . Ram diameter—Maximum stroke—Platen size—Total weight of Platen, ram and dies—Distance and speed of daylight closing—Maximum compression stroke—P. S. I. ram pressure—Time of cycle desired—and any other related facts affecting operation.

●

BUY EXTRA WAR BONDS—NOW

LINCOLN BOOSTER PUMPS
for Hydraulic Systems

●

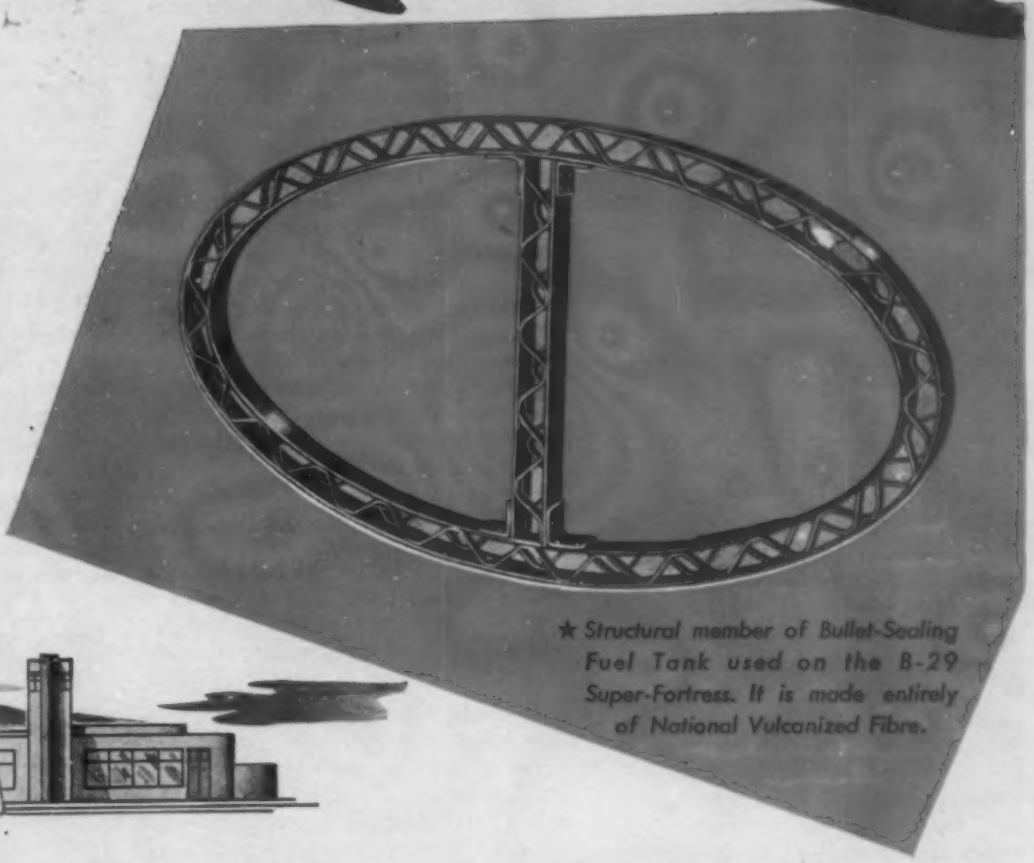
Selected high pressure automatically sustained without horsepower consumption—no by-passing or pressure relief valves.

ARMY (E) NAVY

LINCOLN ENGINEERING COMPANY

Pioneer Builders of Engineered Lubricating Equipment

5101 NATURAL BRIDGE AVE., ST. LOUIS 20, MO., U. S. A.



★ Structural member of Bullet-Sealing Fuel Tank used on the B-29 Super-Fortress. It is made entirely of National Vulcanized Fibre.

Is there an Idea for your New Products in this War-time Use of National Vulcanized Fibre?

National Vulcanized Fibre, because of its remarkable combination of properties—resilience, formability, lightness in weight and exceptional strength—was found to be exactly the right material for this structural member of the bullet-sealing fuel tank of the B-29 Super-Fortress. Its superior resiliency and shock-absorbing qualities protect the tanks from the sudden and great impacts of landing. The same properties that make National Vulcanized Fibre the best material for this and thousands of other war-time applications make it equally practical for countless peace-time uses. National Vulcanized Fibre may be the means of developing new, profitable products for you—of enabling you to get the lead on your post-war competition.

• • •

National engineers are available today to assist you in your current design and research work. Write, phone or wire us

Electrical Applications—National Vulcanized Fibre, in combination with its exceptional physical and mechanical properties, has high dielectric strength which makes it the one best material for numberless electrical and electronic uses.

NATIONAL VULCANIZED FIBRE CO.

Wilmington, Delaware *Offices in Principal Cities*

BELL TELEPHONE LABORATORIES

Exploring and inventing, devising and perfecting for our Armed Forces at war and for continued improvements and economies in your telephone service

RESEARCH, in the Bell Telephone System, has always been an expanding activity, growing with the scientific knowledge of the times and contributing to that knowledge. Upon it have been based important inventions and developments.

The telephone, itself, was invented in the laboratory where Alexander Graham Bell was carrying on researches in speech and hearing and laying the foundation for the electrical transmission of speech. As time went on the telephone research program expanded to cover every science which gives any promise of improved telephony and every engineering art which applies to the development, construction, installation and operation of telephone facilities.

These researches and development studies now cover electrical communication of speech—both by wire and by radio—the transmission of pictures (television)—and many important projects for war.

There Is No End to Progress

Every new research gives rise to new inventions and to new lines for development and design. New inventions indicate new lines for more research. Research and development work, invention and design go hand in hand. In the early years, this work was carried in part by the American Telephone and Telegraph Company and in part by the Western Electric Company, the manufacturing unit of the Bell System.

For many years, however, this work has been assigned to a specialized unit, Bell Telephone Laboratories, Incorporated. Theirs is the responsibility for the technical future of the industry. They carry their developments from the first faint glimmerings which basic researches disclose to the final design of equipment and the preparation of specifications for its manufacture. And after manufacture and installation, they follow their products in operation; and continue development work to devise still more perfect equipment, less expensive, more convenient and of longer useful life.

These policies and procedures of Bell Telephone Laboratories are distinguished by two characteristics. In the first place the Laboratories design for service. The consideration is not the profit of a manufacturer through first sales and replacement models but the production of equipment which will give the best service at the lowest annual cost when all factors are considered, such as first cost, maintenance, operation, and obsolescence. The Laboratories make no profit and the equipment they design is owned and used by the telephone companies; and the emphasis is upon that use.

Organized Co-ordinated Research

In the second place the Laboratories design always with reference to the complete communication system in which the particular equipment is to play a part.

Reliable, economical telephone service, which is the product of its efforts, is not so much an assemblage of excellent apparatus as it is an excellent assembly of co-ordinated equipment—all designed to work together reliably and economically for a larger purpose.

It is not enough that Bell Laboratories shall design a new piece of electronic equipment which has merit or a new cable or telephone receiver. They must design with reference to all the other parts of the communication system so that the co-ordinated whole will give the best possible service.

4600 People in Bell Laboratories

Bell Laboratories contributions to the Armed Forces derived in large part from the technical background that the Laboratories had acquired through their steadily maintained program of research. The Laboratories had special knowledge, skill and techniques which could instantly be diverted to war problems.

At the time of Pearl Harbor, over a quarter of the 4600 people in the Laboratories had twenty or more years of service. This breadth of background made possible many engineering developments outside the strict field of communication and these have been of value to the Armed Forces. So far the Armed Forces and the O.S.R.D. have engaged the Laboratories on over a thousand major projects. The majority of these assignments have been completed; and have contributed to our victories on many fronts.

Most of the Laboratories developments, of course, have been in the field of electrical communication. Communication, not simply between individuals as in ordinary telephony, but between mechanisms—as in the electrical gun director. The Laboratories techniques and electronic researches have produced many secret weapons for our country's Armed Forces.

Leader in Electronic Development

For those problems the Laboratories had a remarkable background of experiences in research and development. In World War I, they pioneered by developing radio telephone systems for talking between planes and between planes and ground stations. They also contributed methods and devices for locating enemy planes, submarines, and artillery.

In this war, Bell Laboratories have pioneered in the field of electronics. The Western Electric Company, which manufactures the designs of the Laboratories, is the largest producer of electronic and other war communication equipment in the United States and is now engaged almost exclusively in the manufacture of this equipment.

In war, Bell Telephone Laboratories devote their work to the needs of our Armed Forces. In peace, they are constantly exploring and inventing, devising and perfecting for continued improvements and economies in telephone service. Centralized research is one of the reasons this country has always had "the most telephone service and the best at the least cost to the public."

BELL TELEPHONE LABORATORIES

Better Bonding Agents from the center of resin research

P-398 PLYOPHEN

Plywood manufacturers are discovering that they need look no further than RCI—leading manufacturer of synthetic resins—for bonding agents for every purpose.

Here are two notable examples—widely useful, readily available, and approved by the Douglas Fir Plywood Association.

P-398 PLYOPHEN is a phenolic resin which can be used as received or thinned with water. It cures in 4 to 6 minutes at 250 to 300 degrees F. and requires only 50 to 250 lbs. pressure. Wood failures are very high. *Outstanding for exterior panel production.*

P-364 PLYAMINE

P-364 PLYAMINE is a remarkably stable, low-cost, water-resistant urea resin. Its low formaldehyde content makes it exceptionally free from noxious fuming. *Excellent for concrete form or hutment grade plywood production.*

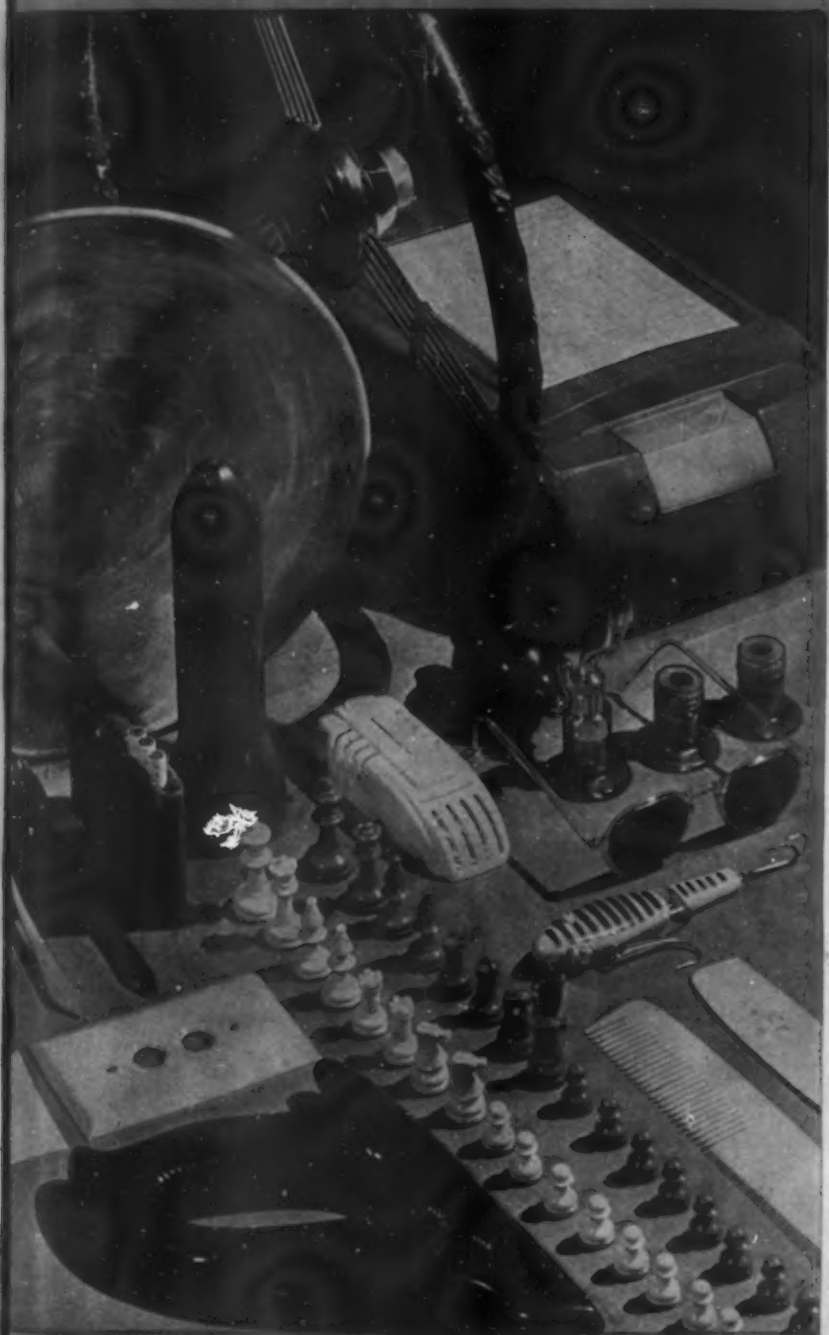
REICHHOLD CHEMICALS, INC.

General Offices and Main Plant, Detroit 20, Michigan

Other Plants: Brooklyn, New York • Elizabeth, New Jersey • South San Francisco, California • Tuscaloosa, Alabama • Liverpool, England • Sydney, Australia

SYNTHETIC RESINS • CHEMICAL COLORS • INDUSTRIAL PLASTICS • INDUSTRIAL CHEMICALS

H-P-M INJECTION MACHINES Are Engineered to Meet All Production Molding Requirements



Molders who have employed H-P-M "All-Hydraulic" injection machines during this busy wartime period know that H-P-M machines are designed for continuous, 24-hour-a-day production. There are many reasons why, but here are two which are important:—

1. ***H-P-M injection machines are designed and built by a pioneer builder, with 14 years injection machine experience, and 68 years experience in building hydraulic machinery.***

2. ***Injection machines are dependent upon their hydraulic components —pumps, valves, controls. Each of these units is designed and built by H-P-M. This unity of origin and manufacture of both operating equipment and machine not only assure coordinated functioning, but also undivided responsibility to the user.***

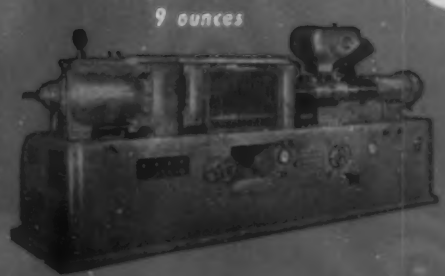
H-P-M injection machines will solve your molding problems. There is a size for every production requirement. Write today for details.

HPM

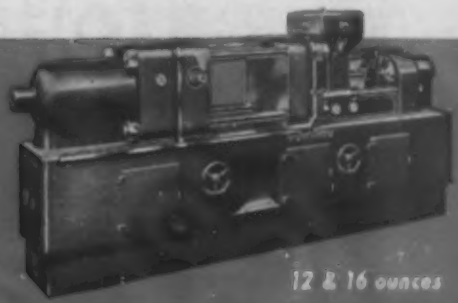
THE HYDRAULIC PRESS MFG. CO.
Mount Gilead, Ohio, U. S. A.

Branch Offices—New York, Philadelphia, Detroit, Chicago
Representatives in Principal Cities
"All-Hydraulic" — © H-P-M Co.

4 ounces



9 ounces



12 & 16 ounces

LEADING SOURCE OF PLASTICS IN SHEET, ROD, TUBE & FIBER FORMS

PLAX SUPPLIES — these materials ↓ / in these forms →	Film & Slab	Rod	Tubing	Fiber
	Depending on the material, film and slab come from .001" to 2.0" thick . . . rod from ⅛" to 6" diameter . . . tubing, to order . . . fiber from .005" to .090" diameter.			
Cellulose Acetate *In all colors, clear to pearlescent*	✓	✓	✓	✓
Cellulose Acetate Butyrate *In all colors, clear to pearlescent*	✓	✓	✓	✓
Ethyl Cellulose *In all colors, clear to pearlescent*				✓
Methacrylate *In all colors, clear to pearlescent*		✓	✓	✓
Polyethylene	✓	✓	✓	✓
Polystyrene *In all colors, clear to pearlescent*	✓	✓	✓	✓
Styramic	✓	✓		

Exclusive Plax developments have included the tough and flexible Polyflex* Sheet and Polyflex Fiber forms of polystyrene. Continuous research work, and a ready understanding of all application problems, make "PLAX FOR PLASTICS" more than a slogan. It should prompt you to ask today for scientific help. Write Plax Corporation, 133 Walnut St., Hartford 5, Conn.

*Trade Mark Reg. U. S. Pat. Office

DEEP COMPRESSION MOLDING with MEGATHERM* Electronic Heat

They said it couldn't be done — but the Kuhn & Jacob Molding & Tool Company of Trenton, New Jersey did it . . . *with Megatherm!*

All previous attempts to compression-mold this heater-coupling with ordinary methods of preform heating, had resulted in rejection ratios as high as 99 to 1. Because of its large size, irregular shape, and variable thickness, it posed a difficult production problem.

But the high-speed uniform heating of the rag-filled resin-bonded preform with Megatherm electronic heat resulted in flawless finished couplings with a smooth surface and minimum flash that passed rigid inspection tests 100%.

Here is another proof that Megatherm can do the job better . . . not only in production problems involving large parts, irregular shapes, and variable thicknesses, but in run-of-the-mill operations.

And as a result, more and more plastic processors are installing Megatherm . . . the modern tool for modern industry. Get the story on Megatherm now.

Federal Telephone and Radio Corporation

*Reg. U. S. Pat. Office

INDUSTRIAL ELECTRONICS DIVISION

Newark 1, N. J.

Announcing

MARKETING and MERCHANDISING

training by

Dr. PAUL W. IVEY

of

PLASTICS INDUSTRIES TECHNICAL INSTITUTE

RECOGNIZING the importance of marketing and merchandising in practical plastics instruction, Plastics Industries Technical Institute has retained the services of Paul W. Ivey, Ph.D., Professor of Merchandising at the University of Southern California. Dr. Ivey has acted as sales counselor for many firms, including Chrysler, Standard Oil, du Pont, Swift, Firestone and Marshall Field—to mention a few.

Dr. Ivey has just completed an extensive trip throughout the U. S., talking with many plastics manufacturers, molders and fabricators to get first-hand information on the present and future merchandising problems confronting the plastics industry. These findings, together with Dr. Ivey's vast knowledge of merchandising, provide Plastics Institute students with timely, useful instruction in this important phase of the plastics field.

This is another example of how Plastics Institute is continually revising and expanding its curriculum to make it of maximum value to the student. We invite your inquiries regarding this practical, comprehensive plastics training. Both resident school and home study courses are offered.

Plastics
INDUSTRIES TECHNICAL
INSTITUTE

Francis A. Gudger, President - John Delmonte, Technical Director

ADVISORY BOARD

E. F. LOUGEE, *Chairman, former editor of Modern Plastics*

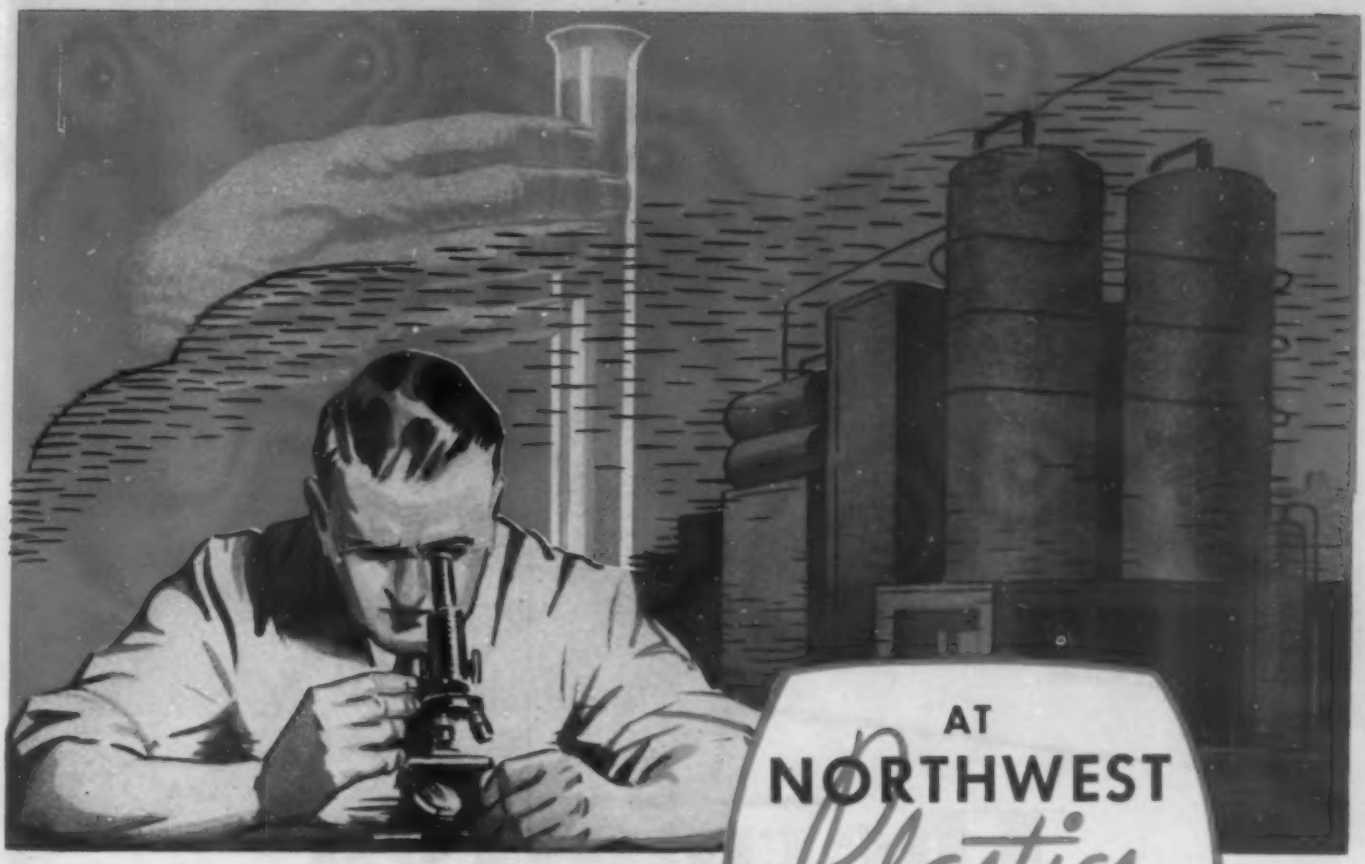
C. W. BLOUNT, *Vice-President, Bakelite Corporation*

DONALD H. DEW, *President of the Diemolding Corporation*

GORDON M. KLINE, *Chief of plastics section, Nat. Bureau of Standards*

WRITE DEPT. MP-1

122 EAST 42ND ST., NEW YORK 17, N.Y. ★ 221 NORTH LA SALLE ST., CHICAGO 1, ILL. ★ 186 SOUTH ALVARADO ST., LOS ANGELES 4, CALIF.



We are Pioneering the Way!

When this Company was founded over five years ago by a small group of young men, new developments in the plastics industry began to occur. The founders of Northwest Plastics were chemists and engineers pledged to contribute to this new enterprise the best of their knowledge and experience.

Two years passed, and then Pearl Harbor became the most discussed event in all the world. Almost over night Northwest Plastics was conscripted into service, and for over three years this company has been making a definite contribution to the war effort. Under war restrictions the nature and quality of our war products must remain secret.

ARMY ORDNANCE AWARD

FOR MERITORIOUS PRODUCTION

We do, however, welcome your inquiries as to the many services we are able to render to concerns interested in post-war markets. Write today. Northwest Plasti[illegible] Inc. 2233 University Avenue, St. Paul, Minnesota.

Compression moulding • Transfer moulding • Injection moulding • Extrusion moulding
Modern Tool and Die Department • Finishing, Fabricating and Assembling Department
Laboratory for Testing Engineering and Product Design.

SOCIETY OF THE PLASTICS INDUSTRY

NORTHWEST PLASTICS inc.

Thermatron

ELECTRONIC HIGH FREQUENCY HEATING

This powerful new force is now available to industry in the **Thermatron** offering–

- **simplified controls**
- **economy in cost and operation**
- **safety for unskilled personnel**
- **guaranteed results**

The **Thermatron** heats, sterilizes, dehydrates, roasts, evaporates, melts and bonds. New applications discovered daily.

Investigate the great potentialities of **Thermatron** internal heat generation —heat without flame—by electronic high frequency currents. It is revolutionizing many manufacturing processes, lowering costs and making possible many new products. Its usefulness has been proved in the following general fields among others—

Plastics	**Ceramics**
Drugs and Chemicals	**Food Products**
Wood Products	**Textiles**

Paper, Rubber, Etc.

Let us fit a* Thermatron *to your factory—sizes 500w to 30kw.

To learn how **Thermatron** Dielectric High Frequency Heaters can work for you, write or phone, stating nature of your application to —*The Manager...*

Thermatron Division

RADIO RECEPTOR COMPANY, Inc.

251 WEST 19th STREET NEW YORK 11, N.Y.

SINCE 1922 IN RADIO AND ELECTRONICS

IF *Extruded Plastics* CAN HELP A STEEL COMPANY THINK WHAT THEY MIGHT DO FOR YOU!

We don't know what profit-making application for plastics extrusions this steel company had in mind when they wrote us for complete information about our extrusion machinery. But we *do* know that no matter what *your* business, there's a big chance that this continuous, simplified plastics production method can offer *you* one or more of these important advantages:

MORE ATTRACTIVE PRODUCT DESIGN. Extruded plastic parts can give your product more sales appeal by adding new smartness, color and richness of appearance.

PACKAGE APPEAL. Extruded plastic containers can be produced economically, can give your product greater attractiveness, can often lower your packaging costs.

EASE OF MANUFACTURING. The extrusion of plastics is a simple, continuous process. Shapes in infinite variety are speedily produced with sizeable savings in time, money and labor.

Industries *of every type*—oil, electrical products, container, pharmaceutical, and scores of others—have written us for detailed information about plastics extrusion equipment because they *foresee tremendous possibilities* for this new, simplified plastics production method. So, *think* what it might do for *you*—in *your* business—to help *your* product!

Write today for further information, without obligation, to National Rubber Machinery Company, America's leading maker of plastics extrusion machinery.

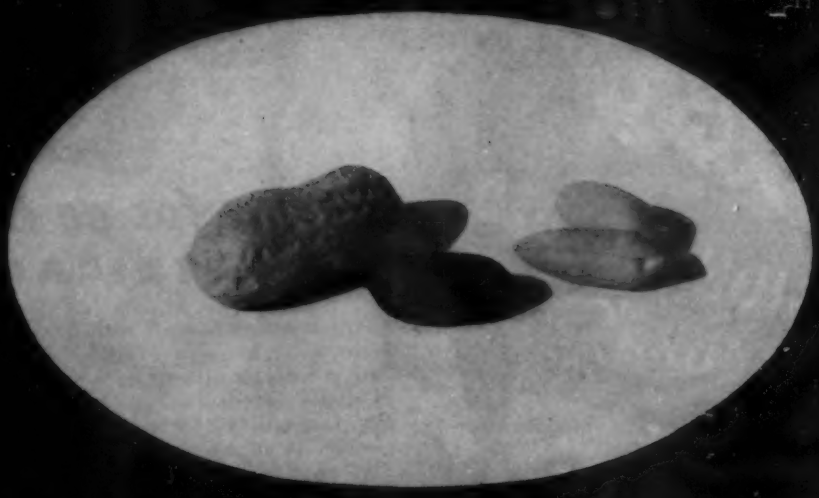
WHY NOT PLASTICS EXTRUSIONS FOR ELECTRICAL CONDUIT?

Some of the product advantages include: lightness in weight and flexibility for easy installation . . . permanent colors for quick identification . . . excellent dielectric properties . . . durable, high strength, moisture and corrosion resistant qualities assure long-life protection of electrical cable. In addition, the process of extrusion is practical, economical, gives close control of all the physical and chemical characteristics required.

NATIONAL RUBBER MACHINERY CO.
General Offices: Akron 11, O.

Plastics
MACHINERY DIVISION

NORTON ABRASIVES



"PEANUTS - - 6c. A TON!"

If You Use Behr-Manning Coated Abrasives

A large producer of peanuts and peanut products had long suffered from high cost and the time required to remove their red skins. Now, that's all changed.

At the suggestion of a Behr-Manning field engineer, Garnet Paper as an abradent was tried with immediate and almost incredible improvement in both speed and economy.

In a hopper at one end of the machine, the nuts lie in their red hulls. The power is thrown on and almost instantly from the other end emerges a mixture of cleaned nuts and skins, whence a suction line whisks away the loose hulls, and the clean, white peanuts fall into a waiting receptacle.

The Garnet Paper involved costs six cents and cleans a ton of peanuts before it has to be changed.

You may not be interested in peanuts, but the same engineering skill and knowledge which enabled our man to contribute to this successful result, are available to *you* to improve jobs you're now doing or to suggest entirely new uses for Coated Abrasives in your operations.

Drop us a line on your letterhead, either to Troy or our nearest branch.

Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Grand Rapids, High Point, Indianapolis, Los Angeles, New York, Philadelphia, St. Louis, San Francisco, Tacoma

BEHR-MANNING • TROY, N. Y.

(DIVISION OF NORTON COMPANY)

Reliable Coated Abrasives Since 1872

Make this resolution!

When you want EXTRUDED PLASTICS come to DETROIT MACOID

We offer this New Year's resolution as a suggestion that will save you time and money and insure satisfaction with your extruded plastics.

In this industry, Macoid is known as the inventor of modern dry extruding. More than that, Macoid's inventiveness has resulted in numerous original applications of plastics extending to all fields of industry.

Macoid is known as the pioneer of extruded plastics in automobiles, aviation, furniture and refrigeration, and many, many more.

Continuing to turn out unusual, successful extrusions, Macoid is your best bet for extruded plastics now or later.

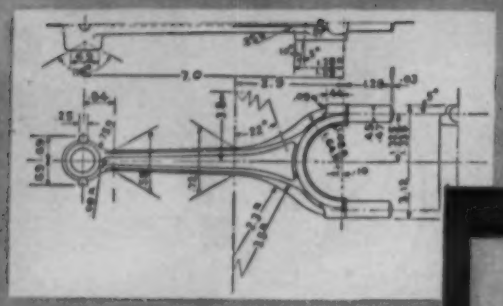
We also do injection molding.

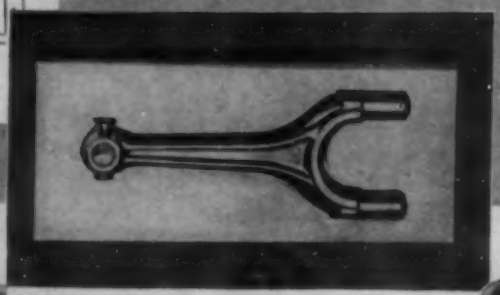
DETROIT MACOID CORPORATION

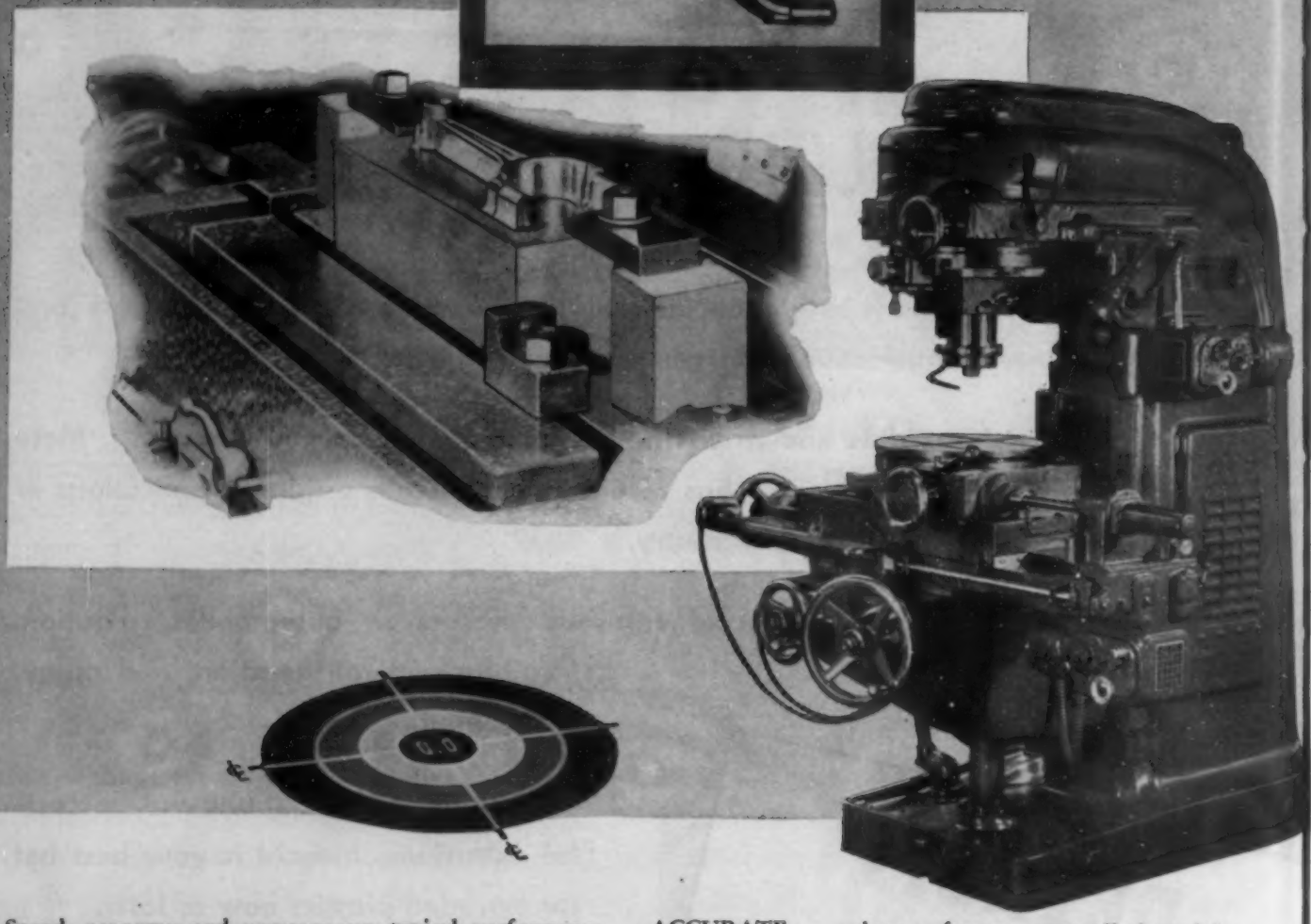
12340 CLOVERDALE AVE.
DETROIT, MICHIGAN

ORIGINATORS OF
DRY PROCESS PLASTIC EXTRUSION

How Many Hours Would You Need to Mill this Master Hob?







Speed, economy and accuracy are typical performance features of a Milwaukee Rotary Head Milling Machine. The milling operation on this master hob is an excellent example. *Read this job report —*

MASTER HOB—MATERIAL—High Carbon—High Chrome Steel. TIME DISTRIBUTION—Set-up, ¾; Layout, 1¼; Rough Mill Complete, 10; Finish Mill Complete, 29. A total time of 41 hours.

Check these advantages of the Milwaukee Rotary Head Milling Machine and how you can benefit from them in your own shop:

DIRECT . . . mills mold cavities in a single set-up without the aid of templets or models.

ACCURATE . . . chances for error are eliminated because there is no change in set-up. Exact control of all combinations of cutting movements — possible only with this machine — transmits mathematical precision to the work.

FAST . . . initial job preparation and set-up time is reduced to the minimum. Accurate performance of the machine saves operator's time and rapid production of intricate molds and dies is the result.

Write for Bulletin No. 1002C and complete information.

BUILDERS OF MILWAUKEE ROTARY HEAD MILLING MACHINE • MIDGETMILL • SPEEDMILL • FACE MILL GRINDER • AUTOMETRIC JIG BORER • CENTER SCOPE.

Kearney & Trecker

Products

CORPORATION

Milwaukee 14, Wisconsin

Subsidiary of Kearney & Trecker Corporation

HOW ELECTRONIC PREHEATING INCREASES PLASTICS OUTPUT

Complete Softening of Plastic Before Molding Speeds Press Operation; Improves Quality

Compression and transfer molding of plastic materials is greatly speeded, rejects are reduced, heavier or more intricate parts can be made, and mold damage is practically eliminated when the molding material is preheated electronically. Some users have reported overall increases in output of as much as 1300% (including increases due to improved quality); a 50% increase in the output of a compression press is a fair average!

WHAT ELECTRONIC HEAT DOES: These remarkable improvements in plastics output are due to the uniformity and speed of heating possible when high-frequency electricity is passed through the plastic material. Although at ordinary frequencies (60 cycles, for example) most plastics are insulators, at high frequencies (million of cycles) they behave like conductors.

The high-frequency current, produced by electron tubes, flows uniformly through the plastic, and is instantly converted to heat. Thus the inside receives as much heat energy as the outside—and at the same time. Temperature increases quickly and evenly. This same heating method can be applied to many other substances—wood, glue, paper, textiles, glass, ceramics, foods, rubber, etc.

RESULTS: Because the plastic material is heated to molding temperature quickly, it has no time to "set" prematurely. The plasticity is high, hence flow into even intricate molds is quick, and molding pressure usually is greatly reduced. This, together with freedom from hard "cores," means less stress on the mold, and virtual elimination of mold damage! Thus runs can be continuous, without shutdowns and expense for mold repairs.

Mold closing is usually speeded, and since heat supplied through the mold has only to advance the temperature relatively little to the "cure" point, the curing time in the mold is reduced. Uniform curing tends to reduce internal stresses, and thus increase dimensional stability and reduce cracking and other rejects. The easy flow of the molding material puts less stress on molded inserts, and is less likely to displace them during molding.

With electronic preheating, no ovens are needed, and the molding material can be heated as needed instead of in batches; heating time totals only a few seconds—usually under one minute—hence molding can begin as soon as the presses are up to temperature in the morning.

IS EQUIPMENT AVAILABLE? Yes. RCA can supply electronic generators for plastics molding, and for many other applications—on priority, of course. If you have a problem, please write us about it in detail. (We'll keep it in confidence.) The coupon will bring you further information. Address: Radio Corporation of America, Electronic Apparatus Section, Box 70-49P, Camden, N. J.

THIS 4-OZ. PIECE of plastic was thoroughly softened for molding in about 15 seconds by an RCA 2000-watt electronic generator.

EASE OF OPERATION is a feature of the RCA 2-kw generator. When plastic material is thoroughly heated, power goes off and cage pops open.

RCA ELECTRONIC HEAT

BUY WAR BONDS

RADIO CORPORATION OF AMERICA

RCA VICTOR DIVISION • CAMDEN, N. J.

WANT ADDITIONAL INFORMATION?

RCA, Electronic Apparatus Section, Box 70-49P, Camden, N.J.

☐ Please send me "Electronic Heat Speeds Plastics Molding"

☐ Please send me information on heating.....by RCA electronic heat.

I understand that this places me under no obligation.

Name .....

Company .....

Address .....

City..... Zone..... State.....

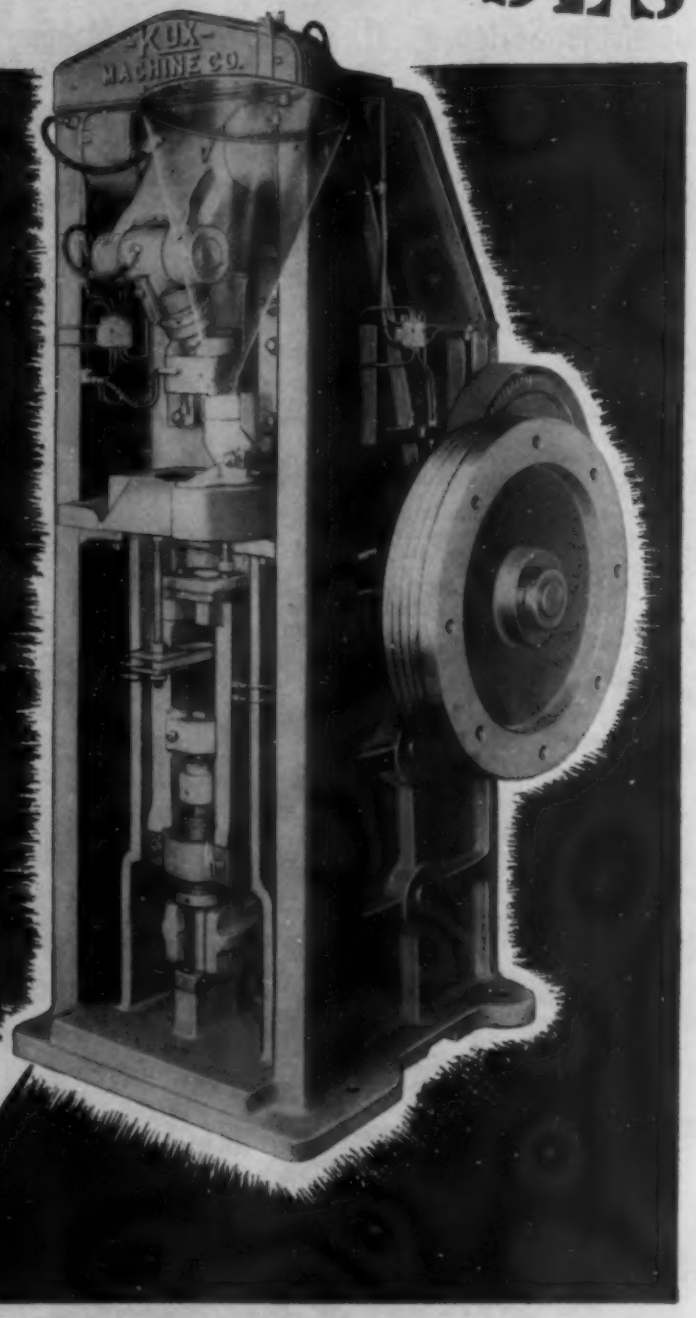
STURDY

KUX PREFORM PRESSES

The new massive Model 65 produces preforms 3" diameter, has a 3" die fill and applies 75 tons pressure

This rugged preform press with its heavy duty, one-piece cast steel main frame will produce odd shapes as well as round preforms. The pressure applied by both top and bottom punches results in more solid, dense preforms, which have less tendency to crumble or break during handling. This new Model 65 press is built to safely withstand high pressures of up to 75 tons at top production efficiency.

Choice of a complete size range of machines in both single punch models and multiple punch rotaries is also available.



WRITE DEPT. P FOR NEW CATALOG OR DEMONSTRATION

KUX MACHINE COMPANY

3924-44 WEST HARRISON STREET • CHICAGO 24

When Designing--

for Beauty...for Durability...for Novelty

MONROE METAL PLATED PLASTICS

give you more . . .

. . . more tensile strength . . . more impact resistance . . . more flexural strength . . . more resistance to wear . . . more resistance to corrosion . . . to temperature flow . . . more control of absorption . . . more dimensional stability . . . more attractive appearance.

Added to these advantages are (1) the characteristic of forming an electronic shield proof against high frequency currents—(2) the fact that metal plating of plastics effects great economies in production of many types of parts

By the Monroe process, plastics can be successfully plated with any metal that lends itself to electroplating.

Designers and engineers are invited to avail themselves of our experience and facilities for specialized research on their particular problems.

Send sketch or sample part for suggestions or estimate

ARMY (E) NAVY

MONROE

MONROE AUTO EQUIPMENT CO. . . MONROE, MICH.

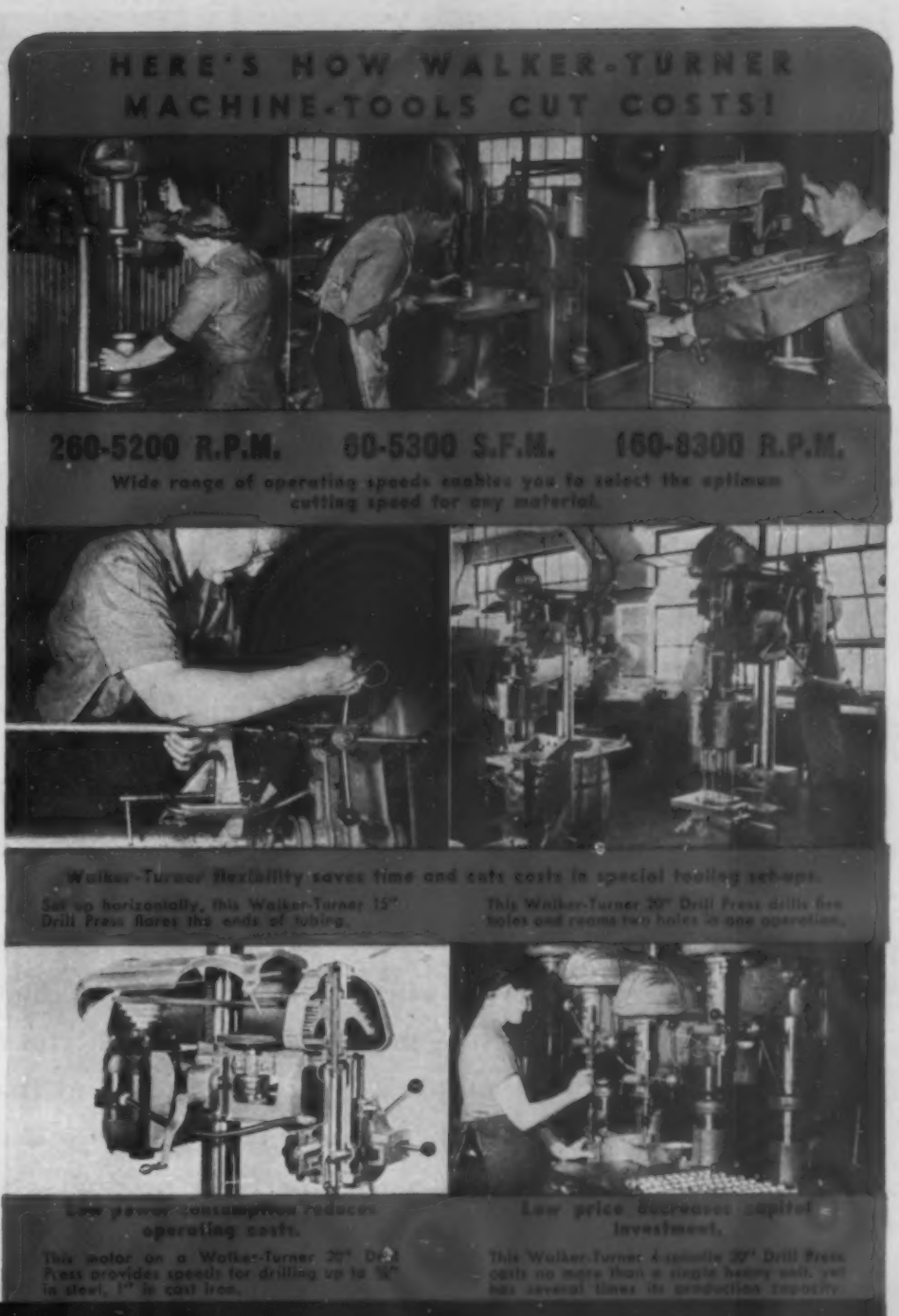
The Metaplast Process

PLASTICS DIVISION

The war years have proven to American Industry that the light machine tool has an important place in Production. Walker-Turner machine tools have demonstrated their ruggedness under most exacting conditions.

Don't let pre-war operating methods affect your post-war competitive position. The versatility of Walker-Turner machine tools will ensure production equal to—and, in many cases, better than—heavier and more expensive equipment.

WALKER-TURNER COMPANY, Inc.
Plainfield **New Jersey**



walker-turner COMPANY, Inc. PLAINFIELD, N.J. U.S.A.

MACHINE TOOLS

DRILL PRESSES • HAND AND POWER FEED • RADIAL DRILLS
METAL-CUTTING BAND SAWS • POLISHING LATHES • FLEXIBLE SHAFT MACHINES
RADIAL CUT-OFF MACHINES FOR METAL • MOTORS • BELT & DISC SURFACERS

PRECISION

Starts here

Here is where efficient plastic production starts, at the drawing board. Here models are developed, the right plastics chosen, the "bugs" eliminated. It is at this point that Precision Plastics Company can start being of real service to anyone interested in the manufacture of plastic parts or products. After the smoke of battle clears away, remember the name "PRECISION," where skilled craftsmen, modern facilities, and practical experience are combined with *personal service*.

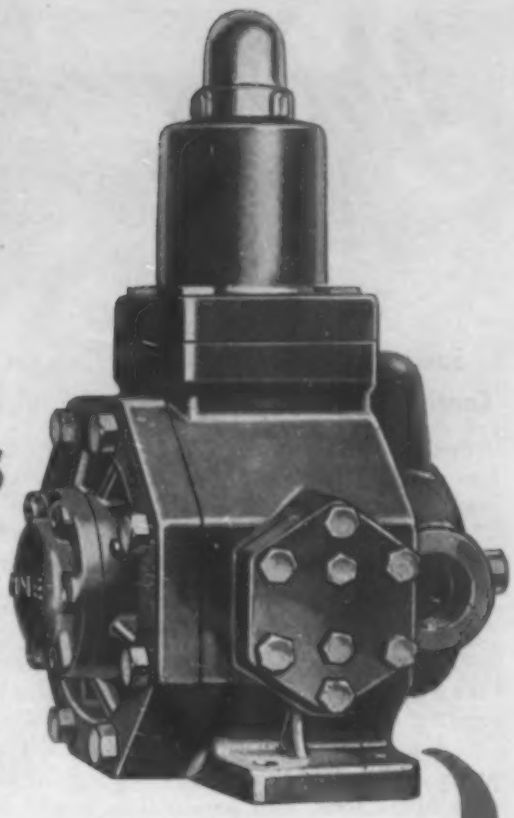
PRECISION *Plastics Company*

4647-61 STENTON AVE., PHILADELPHIA 44, PA.

RACINE

Oil Hydraulic

PUMPS and PRESSURE BOOSTERS



The Variable Volume principle incorporated in the design of Racine Pumps reduces horsepower requirements and provides a great flexibility of operation. These pumping units are of the multiple radial vane type, producing a smooth, quiet delivery at all operating pressures.

Volume ranges from zero to the full capacity of the pump. Changes are accomplished by regulating the relative position of the pressure chamber ring to the rotor. These changes are available under automatic, manual or hydraulic control. High efficiency is inherent in the simple design of Racine Pumps and is safeguarded by skilled workmanship and the maintenance of exacting tolerances on all parts.

Racine Hydraulic Pumps, Valves, Controls and Pressure Boosters have been used for many years in a wide variety of applications. Manufacturers of machine tools, presses, molding machines, lifts, stokers and a large group of other products, have standardized on Racine equipment.

Consult our Engineering Department. Out of their long and varied experience valuable information is available to you without cost or obligation. Write today for a copy of Catalog P-10-C which illustrates the full Racine Line. Address Dept. MP-P.

Racine Variable Volume Pumps — Capacities 12-20-30 G.P.M. Operating Pressures 50 to 1000 lbs. P.S.I. Furnished for either clockwise or counter-clock rotation.

Racine Pressure Booster — Compact, self-contained, requires no special foundation. Available in several ratios. Converts low pressure oil to high pressure in ratios as high as 7 to 1. A simple, hydraulically actuated pumping device adaptable to any circuit. Equally effective with constant and variable volume pumps. 10⅛" high, 8⅛" wide, 18" long.

RACINE HYDRAULIC METAL CUTTING MACHINES

For almost 40 years Racine has built constantly improved high speed Metal Cutting Machines. All capacities from 6" x 6" to 20" x 20" are available. See these machines as illustrated in catalog No. 12. Select the model best adapted to your production, maintenance or tool room job.

STANDARD FOR QUALITY AND PRECISION
RACINE
RACINE TOOL and MACHINE CO.

RACINE TOOL and MACHINE COMPANY
Standard for Quality and Precision
RACINE, WISCONSIN, U. S. A.

How many man-hours can you spare FOR NEEDLESS TAPPING?

Sperry saves machine shop time on Aircraft Controls with the SIMPLER P-K Fastening Method

Sperry Products, Inc., Hoboken, N. J., make the Exactor Hydraulic Remote Control widely used on aircraft, army and navy vessels, and in many war plants. Their heavy production schedules can be met only by ruling out every needless assembly operation. That's why Sperry uses Parker-Kalon Self-tapping Screws wherever possible to eliminate tapping.

"At a busy time like this," says a Sperry Engineer, "it's a great relief not to have to tap holes for machine screws. All our tapping is done in our machine shop, which is up to its neck in other work. Tapping these parts would tie up machines needed for other important operations, and production would be seriously delayed."

Can you spare scarce man-hours for needless tapping? *Question every fastening job!* See if it can be done the simple, Self-tapping Screw way before putting up with slow, complicated methods. Experience proves that, in 7 out of 10 cases, P-K Self-Tapping Screws will simplify metal and plastic fastening jobs . . . save time . . . speed production . . . lower costs . . . and often increase fastening strength.

Call in a P-K Assembly Engineer for help on your fastening problems. You'll find his advice unbiased. If you prefer, mail a brief description of fastenings for recommendations. Parker-Kalon Corporation, 208 Varick Street, New York 14, N. Y.

EIGHT P-K TYPE "F" SCREWS are used to fasten a gasket retainer to the transmitter cover. Screws are driven through the metal gasket retainer and gasket into the aluminum cover.

Four P-K Type "U" Screws are also used to fasten a metal name plate to each unit.

SELF-TAPPING SCREWS FOR EVERY METAL AND PLASTIC ASSEMBLY

PARKER-KALON

Quality-Controlled

SELF-TAPPING SCREWS

They're Both Plastics

They're Both by Cruver

The propeller protractor is a precision instrument made by molding, die cutting and marking plastic, assembling with appropriate metal pieces. It is used for checking propeller pitch out in the field, away from elaborate instruments. It is engineered and manufactured by Cruver.

The mirror and brush show another side of plastics. Here, beauty is the criterion. Molded of a transparent material, the design is integral. Decoration is applied to the reverse side — can never be rubbed off or chipped. This process is capable of reproducing many colors in a beautiful three dimensional manner. This item is also designed and engineered by Cruver.

The contrast between these two applicatians of plastic materials points a moral for all industries: that Cruver is indeed more than "a great name in plastics". Cruver is a great performer, too.

Cruver

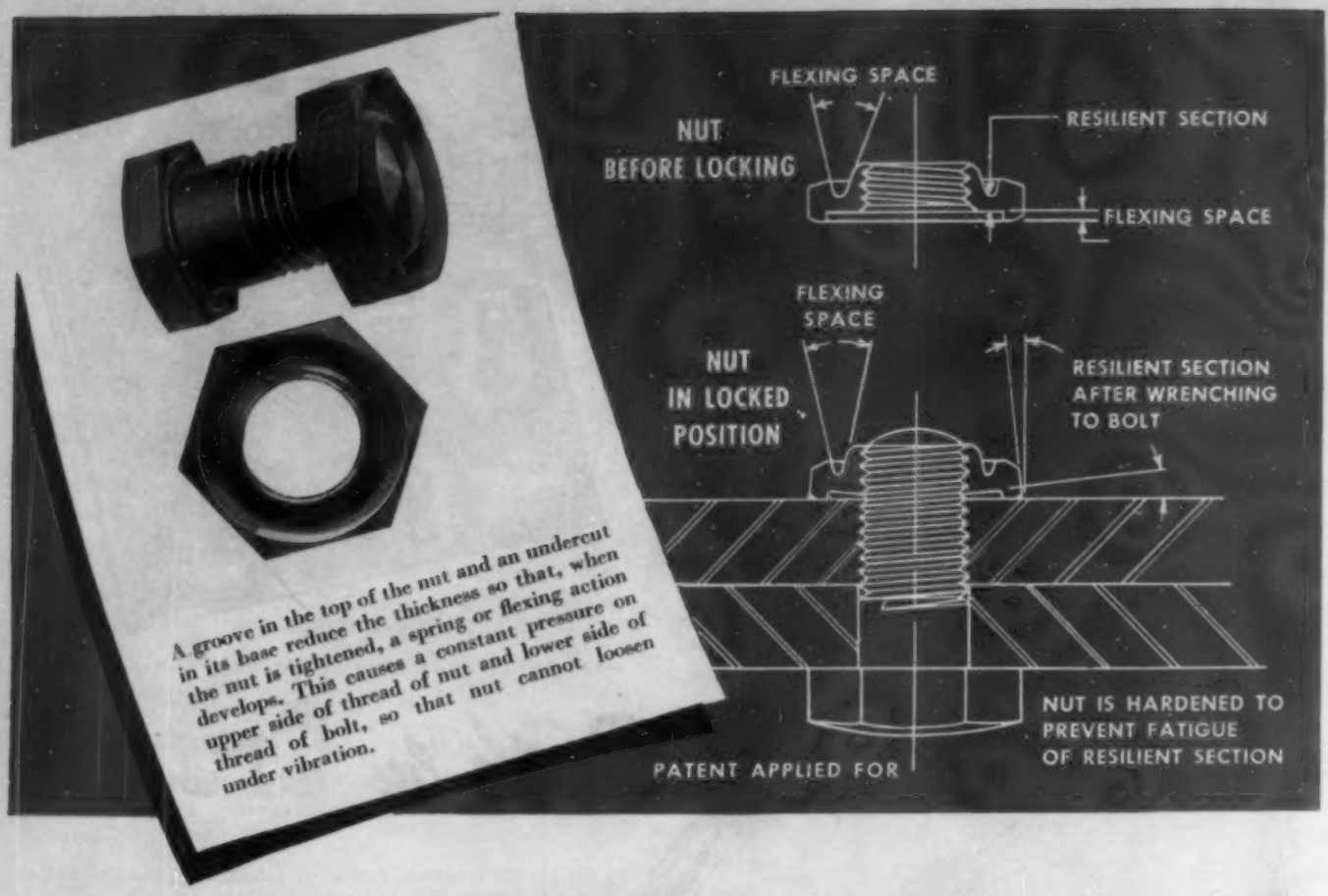
MANUFACTURING COMPANY

NEW YORK
2 West 46th St.
Wisconsin 7-8847

CHICAGO
2456 W. JACKSON BLVD.
Seeley 1300

WASHINGTON
Hotel Washington
Met. 5-900, Ext. 650

SPECIALISTS IN CONVERTING PLASTICS TO WAR
LEADERS IN POST-WAR PLANNING, TOO



MAKE SURE *YOUR* PRODUCT WON'T HAVE THE "WOBBLES"

This is no ordinary bolt and nut. It is new and unique . . . a custom-made cure for the "wobbles". It illustrates how manufacturers are improving their products by consulting with National *on fasteners:*

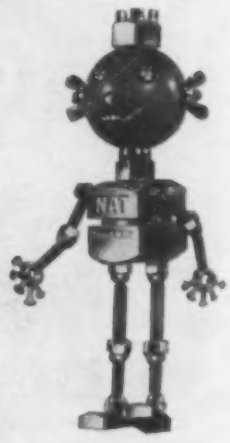
The American Fork and Hoe Company, in redesigning their new line of "True Temper" products, needed a bolt and nut assembly for certain applications that would lock up tight, yet permit delicate adjustment for proper functioning of the tools, and be capable of easy disassembly for sharpening.

The nut had to be thin, light in weight, one-piece construction. Existing types of lock nuts were too cumbersome.

They put it up to us to find the answer. We designed a new type of lock nut (patent applied for) which, when tightened, develops a *spring* or *flexing* action that eliminates the possibility of the nut loosening in action.

Appearance was a factor, too. This was improved by making the top of the bolt slightly oval, and rounding the point so as to blend in assembly with the radii of the nut.

Let us diagnose *your* products for possible fastener improvement. It's often surprising what can be done.



National
HEADED AND THREADED
PRODUCTS

THE NATIONAL SCREW & MFG. CO., CLEVELAND 4, O.

MODERN PLASTICS
JANUARY, 1945 · VOLUME 18 · NUMBER 5

Advances in plastics during 1944*

by G. M. KLINE

RAPID progress has been made during the past year, not only in materials and methods already well known to the industry but also in the development of new materials and methods introduced during the war period. This survey reviews these advancements in terms of their contribution to the war effort and their postwar significance.

THE resources and energies of the plastics industry during 1944 were spent in performing wartime assignments. But the hopes and plans of all were directed toward the challenge of the reconversion market that will follow "V-E" day. Surveys of potential customers of the industry have indicated that a desire to use plastics more extensively than in prewar years exists, but that experience gained in the manufacture of war materiel has developed a keen appreciation of performance requirements. Forums on potential markets in the merchandising and building fields conducted at the November Conference of the Society of the Plastics Industry[1] gave definite evidence that the plastics industry must adopt simple terminology and recognized standards for its materials in order to gain their fullest acceptance by consumers.

Statistics[2] published during the year indicate that the industry has had a tenfold growth during the past decade. The total production of synthetic resins during 1943 was a record figure of 650,000,000 lb. and will probably approach very close to 700,000,000 lb. for 1944.

A survey[3] of the materials and machines used in compression, transfer and injection molding revealed that during the war years 1942–1944 there has been a 44 percent increase in the number of compression presses as compared to a 23 percent increase in thermosetting molding compound. The 165 percent growth in thermoplastic molding powder production since 1941 has been accompanied by an 85 percent increase in the number of injection and extrusion machines, with the capacity of these new machines far exceeding that of the older and smaller machines. These figures give ample evidence of the ability of the plastics industry to handle the volume of business that will accompany resumption of civilian production. A tally of the molding industry showed that plans have been made for a 20 percent postwar expansion.

Materials

The panorama of materials development during 1944 is one of steady growth of the already familiar products rather than the introduction of radically new types of compounds. The wartime arrivals announced in last year's review have now fulfilled their early promise and are making important contributions in war materiel. The properties and potentialities of these materials were detailed in previous articles.

Polyethylene which has been in commercial production in this country since 1943, is used practically exclusively for the insulation of high-frequency wire and cable. Several reports[4–6] on its characteristics have indicated that many other important uses may be expected from its combination of flexibility and toughness over a wide range of temperature, low water absorption and impermeability to moisture, chemical inertness and excellent electrical properties. These possible applications include containers, gaskets, battery parts, packaging films, chemical equipment and flexible tubing of various types.

The new class of high polymers called silicones has also been the subject of extensive recent reports.[9, 10] These organo-silicon oxide polymers include fluids for use over a wide temperature range with little change in viscosity, chemically resistant greases, insulating resins and high-temperature lubricants. The new high-temperature silicone insulation has made it possible to reduce the size and weight of electrical motors, to greatly increase the service life of insulation in conventional equipment, and to operate in ambient temperatures and humidities much higher than those permissible for previous types of organic insulation. These resins have provided the basis for the greatest advance in electrical insulation since the advent of glass fiber, tapes and fabrics. Silicones in many other forms are in the laboratory stage.

Plastics engineers are well aware that the 400 million pound plant capacity for the manufacture of styrene, built to meet the requirements of the synthetic rubber program, represents a tremendous potential source of raw material for the production of polystyrene and styrene copolymer resins after the war. The forerunners of numerous developments in this field were announced in 1944. The new styrene copolymer resins,[11] known as Cerex, have A.S.T.M. heat distortion points ranging from 195 to 300° F., compared with 169° F. for polystyrene. Their mechanical properties are fully equivalent to those of polystyrene and their electrical properties are superior to most thermosetting materials. Cerex is also characterized by low water absorption, excellent chemical resistance, zero plasticizer content, and—perhaps most important of all for a thermoplastic material—dimensional stability under severe service conditions, as indicated by its resistance to boiling water in a 48-hr. test. Actual and potential wartime applications for these compounds include coil forms, condenser cases, battery jars and accessories, crystal holders, switch parts and surgical instruments.

Another new styrene derivative of improved heat resist-

* Presented before the Rubber and Plastics Div. of the American Society of Mechanical Engineers, New York, N. Y., Nov. 30, 1944.

PHOTO NO. 1, COURTESY CANADIAN INDUSTRIES, LTD.
PHOTOS NO. 3 AND 4, COURTESY GLENN L. MARTIN CO.
PHOTO NO. 5, COURTESY PLASTICS INDUSTRY TECHNICAL INSTITUTE

1—The excellent electrical properties of polyethylene make it particularly adapted to the insulation of high-frequency cables. 2—The soles, heels, welts and uppers of these shoes have been calendered and molded of vinyl latex. 3—Four types of expanded materials—hard rubber, phenol-formaldehyde, fiber resin and cellulose acetate—employed as cores in sandwich construction. 4—An entrance hatch door for a medium bomber, typical of the semi-structural aircraft parts fabricated from sandwich material. 5—Plaster of paris figures impregnated with 100 percent furane resin

ance is polydichlorostyrene,[12, 13] which has been designated as Styramic HT by one manufacturer. This material has an A.S.T.M. heat distortion point of 236° F. and electrical characteristics somewhat better than even polystyrene. Hence it is used for the present in ultra-high frequency insulating parts in secret war equipment.

Styrene resin has also become available in a new form,[14] as extremely fine fibers ranging in size up to 0.0002 in. in diameter. This polyfibre makes possible low-pressure bag molding of large thermoplastic polystyrene parts and permits controlled specific gravity gradients throughout the molding up to 1.05. The material is also of interest for thermal insulation and as a replacement for kapok in applications requiring buoyancy, such as floats, life vests and emergency-rescue equipment.

The vinyl resins continue to expand both in volume of production and versatility of application. The 1944 industry survey showed that present monthly production of plasticized vinyl compounds is in the neighborhood of 15,400,000 lb., which is a 440 percent increase over the 1941 figure. A new series of vinyl-vinylidene chloride copolymers[15] was announced under the name Geon. Resistance to aging, corrosion, solvents, flexing and abrasion, coupled with the adaptability of the materials to practically all plastic processing techniques, accounts for employment of these vinyl resins in electrical equipment, extruded tubing, screening, gaskets, coated fabrics and papers, packaging films and molded aircraft and motor vehicle parts.

A high solids water dispersion of vinyl chloride resin,[16] known as Geon latex, has been found to be suitable for impregnating paper and fabric and for the manufacture of hospital sheeting and foul weather clothing. The latex method eliminates costly solvents and solvent recovery systems and promotes better adhesion of the resin to fibrous bases.

A somewhat related technique is that utilizing a dispersion of the vinyl resin in a solvent plasticizer or mixture of solvent plasticizers.[17] This paste is spread-coated on cloth, dip-coated on forms, or squirted under low pressure into molds, and fused into a homogeneous, tough, elastic film or molding by heating at a temperature of 300 to 350° F.

A vinyl resin made by copolymering 85 parts vinyl chloride, 15 parts vinyl acetate and 1 part maleic acid was found to give coatings which adhere well to smooth surfaces after air-drying.[18] The good adhesion is attributed to the presence of unreacted carboxyl groups contributed by the maleic acid.

Resorcinol-formaldehyde resins,[19] which cure rapidly at temperatures from 60 to 150° F. under nearly neutral conditions, have been found to be especially advantageous for assembly bonding of wood and other materials which are deteriorated by the strong acids used in cold-setting urea and phenolic glues. One resin of this type, called Penacolite, has been used in the production of laminated white oak timbers for shipbuilding, manufacture of plywood sheet and tubing, and bonding of plastics, rubbers and metals. The potential fields of application for these resins in the postwar market include laminating, molding, casting, coatings and grinding wheel production, as well as bonding of parts for marine use, aircraft, furniture and building construction.

Portents of things to come in furane resins[20–22] were described during 1944. The raw materials for these resins include furfural, furfuryl alcohol, and furoic acid. One hundred percent furane resins which can be molded, laminated, cast, sprayed as air-drying coatings, and used as adhesives and impregnating agents, have been developed experimentally.

Important advances were made in the fabrication and utilization of laminates. The unsaturated polyester resins, such as the Columbia Resins,[23] Laminac, Marco resins, Thalid—Monsanto X-500 series, and Plaskon 900, were used to bond glass fibers into sheets which were tested for mechanical strength and other physical properties.[24] The rear fuselage section, tail cone, and side panels of the BT-15 airplane were constructed by the Army Air Forces Aircraft Laboratory[25] of glass cloth bonded with Plaskon 900 and subjected to static tests. Detailed information[26–30] on other aspects of the preparation and properties of low-pressure glass laminates was published in conjunction with the announcement of the construction and flight tests on this first successful laminated plastic aircraft primary structure. The influence of various factors on the mechanical properties of paper-base laminates[31, 32] and their applications[33, 34] were discussed.

The terms "sandwich materials" and "expanded (or foamed) plastics" have been frequently mentioned in the plastics literature of 1944 and are destined to become common parlance during the next few years. The advantages of sandwich construction involving stiff, dense faces separated and stabilized by thick, light core have long been known. In the aircraft industry considerable interest has been stimulated in sandwich materials by the ever-increasing difficulty of maintaining rigid contours in high-speed aircraft. This type of construction was employed for the resin-glass fuselage built by the Army Air Forces. Excellent discussions of the principles and problems involved have been published recently.[35, 36] Balsa wood has generally been employed on aircraft as the porous stabilizing medium, but research is currently in progress to develop more satisfactory low-density materials from plastics. Phenolic and urea resins, polystyrene, polyvinyl chloride, cellulose acetate, allyl resins, and natural and synthetic rubbers have been expanded into porous structures by various methods.[37–38]

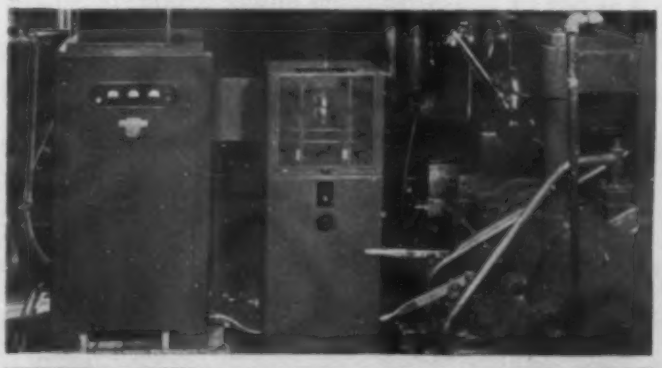
Significant reports were published concerning impact-resistant moldings made with pulp[39] and creped paper,[40] use of resins in impregnating and bonding wood,[41–46] and plastics made from lignin[47, 48] and wood.[49] Agricultural products as sources of raw materials for the plastics industry were considered in papers dealing with plant residues,[50] starch,[51–53] and zein.[54, 55] Other noteworthy papers dealt with the structure of phenolic resins,[56] increasing the solvent resistance of cellulose ester moldings,[57] and polyvinyl alcohols.[58]

Molding and fabricating

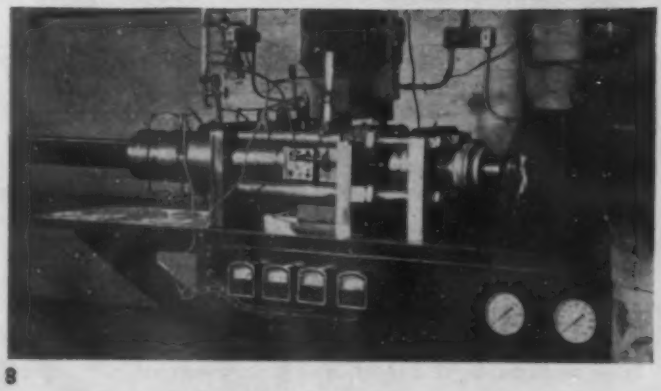
The sweeping advances in the development of high-frequency preheating equipment and the utilization of this technique in speeding production and solving heavy-section molding problems make this process outstanding in the roster of 1944 accomplishments in the plastics industry. The record on industrial parts now being heatronic molded[60–63] is one of amazing reductions in curing time with concomitant savings in manpower and machine hours. Curing time of a propeller block is reduced from 12 to 2 min.; telephone handset, 8 to 3 min.; airplane control pulley, 5 to 1 min.; ignition part,

6—This high-frequency heating installation facilitates the molding of heavy sections. 7—Aircraft parts molded by low-pressure techniques. 8—This new injection and extrusion machine offers unusual possibilities in the thermosetting and thermoplastic fields. 9—Large parts such as this rowboat are made possible by the use of contact-type molding

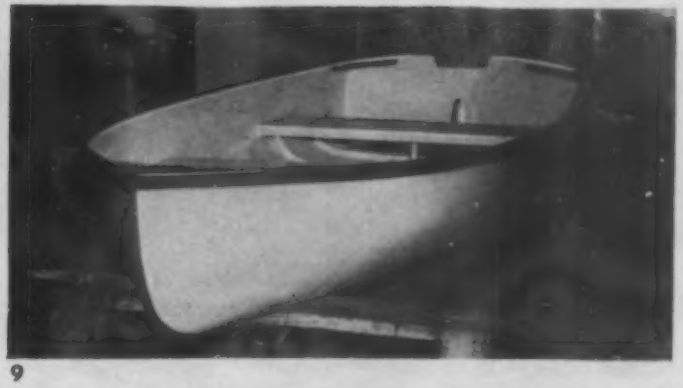
6 PHOTO NO. 6, COURTESY INDUCTION HEATING CORP. PHOTOS NO. 7 AND 9 COURTESY AMERICAN CYANAMID CORP.



7 PHOTO NO. 8, COURTESY CHRYSLER MOTOR CORP.



8



9

6 to 1 minute. The process has also found further application in the fabrication of plywood[63, 64] and laminate[65] parts.

The principles involved in high-frequency heating were reviewed by several authors.[61, 66, 67] The normal path of the electrons of nominally non-conducting molecules is disturbed by the rapidly alternating electric field, releasing energy in the form of heat. This dielectric hysteresis is comparable to the generation of heat due to mechanical hysteresis when a rubber band is stretched and released rapidly and repeatedly. It has been suggested that, aside from the temperature aspect, the molecular agitation caused by high-frequency heating also greatly accelerates the intermolecular change that takes place during polymerization.

The adaptation of the injection and extrusion molding processes to thermosetting plastic materials has been another highlight of the year. This represents a potential shift of the favorable price factor for small molded parts, in which molding costs bulk high, back to the thermosetting materials which lost it ten years ago to the injection molded thermoplastics. One machine with motor-driven screw has proved in tests to be satisfactory for injection molding and continuous extrusion of thermosetting and thermoplastic materials and natural and synthetic rubbers.[68] Experimental rocket launching tubes have been made by the continuous extrusion process with this apparatus. The injection molding process has been used to make truck coil cases from a variety of thermosetting materials.[69] Better strength properties, a 250 percent saving in curing time, and reduction in the number of dies required are among the advantages attributed to this new molding technique. Other innovations in machines for injection[70–72] and extrusion[73] molding were described. Special problems relating to the extrusion of ethyl cellulose[74] and vinylidene chloride[75] were discussed.

Design of molds[76–78] and plastic parts[79–83] and the art of molding generally[83–86] were the subject of many papers published during 1944. The long-standing problem of less costly molds was considered in reports on electrodeposition of molds[86] and the use of cast zinc alloys.[87] Fabrication of thermoplastic sheets into aircraft parts and miscellaneous shapes was accomplished by free-blowing[88–90] and die forming.[91] Further developments in metal plating of plastics were reported.[93–94] The opposite technique of plating plastics on other materials by an electrophoretic process was also described.[95] Directions were given for depositing films of rubber, waxes, resins, cellulose and bitumens.

New information on the spreading and curing of resinous glues in the manufacture of compreg[96] and plywood[97–99] was published. Further advances were made in the art of low pressure molding and laminating.[100–102] The post-forming of thermosetting laminates, first described in 1943, became an important factor in the production of large parts for Army bombers, including fairings, ammunition boxes, ejection chute scoops, light brackets and deflector rings.[103] These post-formed laminated parts require approximately one-third the number of tools necessary for the forming of metal, cost about 50 percent less than the corresponding metal parts, and are from 25 to 50 percent lighter. The forming properties of vulcanized fibre were also described.[104]

Applications

The record of 1944 with respect to utilization of plastics in the war effort has also been primarily one of concentration on items tried and proved in the preceding two years. Bomb burster tubes,[105] M-52 fuzes,[106] rifle butts,[107] resinous coatings for steel cartridge cases,[108] medicine containers,[109] medical equipment,[110] mess trays,[111] screening,[112] and range-finding equipment,[113] are among the long list of Army supplies employing plastics. In fact, the ordnance items mentioned here remind us that plastics, too, are ammunition and that the year end emphasis on expanded production of bullets and shells means a further tightening of the supply situation. The lookout alidade,[114] compasses,[115] escape hatch covers,[116] and anti-fouling coatings[117] are among the Navy's requirements that continued to be met with plastics.

The outstanding new application of plastics for military purposes in 1944 was the rocket launching tube.[118] These tubes which are 10 ft. long and have an inside diameter of 4 1/2 in. are mounted in clusters of three on the underside of fighter planes. They are made by rolling paper impregnated with phenolic resin on to mandrels and baking at 105° C. for 6 1/2 hours. Among the advantages attributed to the plastic "flying bazooka" as compared to steel and magnesium tubes are lighter weight, resistance to corrosion, and reduction of the hazards involved in the event of malfunctioning.

Another noteworthy development reported during the past year was the production and evaluation of the plastic housing for the 6 × 42 combat binocular.[119] The rigorous requirements for dimensional stability in order to maintain alignment of the optical systems were met by the selection of a phenolic-asbestos composition and thorough stabilization of the housings by a baking treatment. The extreme resistance of the instrument to fungus growth, corrosion and moisture penetration and its superior behavior in maintaining optical collimation under impact conditions make the plastic binocular well suited to amphibious and tropical operations.

The aircraft industry continued to be an important source of new activities in plastics. Several reviews of present practice and future possibilities in this field were published.[120–122] Applications described include glider control tabs,[123] propeller parts,[124–125] turret units,[126] oxygen equipment,[127] portable hangars,[128] navigational instruments,[129] flooring,[130–131] and signalling lamps.[132] Developments in transparent enclosures included a laminate made by bonding methacrylate plastic with an interlayer of polyvinyl butyral to produce a glazing for pressurized cabins capable of being penetrated by machine-gun and cannon fire without shattering.[133] Aircraft safety glass[134] of an improved design and streamlined eyes[135] for the B-29 are other 1944 newcomers in which transparent plastics are employed.

Kirksite dies were successfully employed for the molding of antenna mast parts and inner skin frames for aircraft doors.[136] Detailed information was supplied regarding the use of plastics for drill and assembly jigs, machining fixtures and mechanical press dies.[137–139] Adhesives for bonding metal to metal or wood are of increasing interest to the aviation industry.[140, 141] The development of a sprayed-on vinyl resin film to protect aircraft during trans-oceanic shipment[142] took its place along side of the earlier practice of dipping metal parts in a molten ethyl cellulose composition to protect them from corrosion and yet have them ready for immediate use by simply stripping off the plastic film.[143]

The building industry continued to explore the possibilities of using plastics in prefabricated housing and other architectural outlets.[144–147] Design, standardization, costs and recommendations regarding research were considered in the report of a British committee on plastics for housing.[148] The potentialities of the low-pressure glass-plastic moldings for prefabricated bathroom-kitchen units, refrigeration, furniture and household appliances are based on low tooling costs for large sections, light weight, and ease of assembly.[149] Some thought has also been given to the place of plastics in fluorescent lighting fixtures for the home.[150] (*Please turn to page 186*)

The year in P.M.M.A.

JAMES L. RODGERS, JR.
president, P.M.M.A.

THE Plastics Materials Manufacturers' Association, although organized prior to the present emergency, has of necessity become very active in many lines associated with the war program. For the benefit of the plastics industry in general, and because of increased industry requirements, it was decided to expand the Association's activities during 1944. Greater emphasis has been placed on technical and allied lines to permit better operations with Government agencies as well as with other manufacturing groups and institutions.

Broadly speaking, the problems peculiar to the plastics materials manufacturer do not, of necessity, require an extensive program, as in the case of industry groups embracing many members. It has been the object at all times to reflect the materials manufacturing industry's position in general and technical matters, to represent the group on the materials produced by them, and to cooperate fully with the various Government agencies, the producers of the basic raw materials, and the fabricators of plastics. Only those problems peculiar to the materials manufacturers are handled by Plastics Materials Manufacturers' Association.

The Association has given serious consideration to such of the members' activities as could rightfully be serviced by the organization. After considerable study it was decided that the membership should consist of those engaged in the manufacture of synthetic resins and cellulose plastics and compositions thereof, primarily for sale in the form of adhesives, castings, molding and extrusion compositions, and sheets, rods and tubes. Therefore, the program now includes activities along these lines of materials manufacture. In this way it is believed the important parts of the plastics industry not formerly being served by a materials manufacturers association are more adequately represented. The merger with the Resin Adhesive Manufacturers' Association was effected during the latter part of the year as a result of this program.

Increased use of plastics in the war effort and the potential use of these materials in postwar civilian products because of general public acceptance and expectation of new plastics products has greatly intensified the demand for technical data and general engineering information concerning them. The technical data book on plastics materials prepared by the technical men of the Association during the latter part of 1943 was so well received by the industry that the original issue was out of print within six months. During 1944 a new edition was in preparation; this should be available soon.

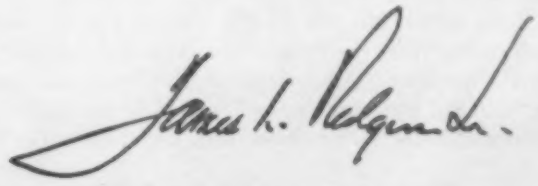
The regular Technical Committee has been assisting the various Government agencies in drawing up proper specifications for plastics materials and products therefrom. The Resin Adhesive Division Technical Committee has performed similar functions with regard to products for that branch of the industry. It has always been the objective of the Association that these groups should not duplicate work of others but should be a supplement to and present a common technical viewpoint of the materials manufacturers.

The growing demands for plastics in the War Program and more especially in reconversion have indicated the need for fundamental research on plastics. Therefore, the Association took steps to establish a research program at the Massachusetts Institute of Technology on this general subject. The initial work, to begin early in 1945, will include a broad survey of the industry to determine the needs of certain specific fundamental research studies on engineering properties of plastics and to formulate a long-range program. This work will in no way duplicate the research activities of the individual members or other existing bodies. The American Society for Testing Materials is cooperating with the Association in this undertaking. This type of research, although new for the plastics industry, has proved very beneficial to other industries and is one which the Association is proud to sponsor in cooperation with the Massachusetts Institute of Technology.

It is planned to initiate a standardization of colors on one plastic material with a view to elimination of waste and obsolescence in the fabricators' plants as well as for the ultimate consumer.

During 1945, as materials become available for civilian production, the plastics industry will be faced with many demobilization and reconversion problems. It will be the Association's policy to cooperate with Government as well as private organizations to the benefit of industry as a whole.

There have been increases in certain basic raw materials and in some instances the plastics materials manufacturer has had an expansion in facilities. The materials that are now available to the fabricators of plastics are in larger supply and of a quality superior to that possible before the war. Many new developments in plastics are covered elsewhere in this issue. With the hope for early termination of hostilities, the materials manufacturers are prepared to supply an increasing amount of plastics to the industry for the accelerated production of civilian products.



SPE activities for 1944

THE Society of Plastics Engineers, Inc., was established at Detroit in 1941 under a Michigan charter as a non-profit professional engineering society to parallel specialized technical associations in other fields. Its membership is composed entirely of plastics engineers, who meet to discuss problems related to the design, manufacture and use of plastics and their allied products. During the summer of 1944, the Board of Directors approved a constitution to be incorporated in the charter which will serve as a guide for a slightly altered set of by-laws. Experience indicated that the old by-laws could be improved upon, especially as they related to the technical committee's organization.

The National Board of Directors in 1944 consisted of Charles C. Henry, Chicago Die Mold Manufacturing Co.; William B. Hoey, Plastics Processes Inc.; L. S. Shaw, Shaw Refractories, Inc.; George Clarke, Owens-Illinois Glass Co.; William Goggin, Dow Chemical Co.; N. Rakas, Chrysler Corp.; John Mickey, Ford Motor Co.; Harry McGowan, Bakelite Corp.; Robert Morehouse, Cardinal Corporation.

The society aims to promote the science, standards and engineering practices associated with the design, construction and utilization of plastics products. Emphasis is placed on the stimulation of social intercourse, and on mutual co-operation among plastics technicians. Information is exchanged, a monthly news bulletin is published, and monthly meetings of geographical sections are held. Sections are rapidly being established in all centers where plastics are used and manufactured. The membership is growing rapidly, having exceeded the 500 mark in 1944.

In 1944, under the presidency of Charles C. Henry, new and active sections were established in Toledo, Cleveland, Indianapolis and St. Louis. Excellent programs of a technical nature are offered at least monthly in all sections. These sessions are usually keynoted by some nationally known plastics scientist. However, symposia restricted to engineers from a local section have produced some of the most profitable meetings. Industrial movies supplement many of these lectures. Through these meetings, plastics technicians have become more widely acquainted and have been afforded the opportunity of meeting the outstanding leaders in development and research.

The 1944 Section Presidents were—Charles Hamilton, field engineer, Kurz-Kasch, Inc., Detroit; W. T. Cooper, field technician, Bakelite Corp., Chicago; E. S. Rhinehardt, district manager, Spaulding Fibre Co., Inc., St. Louis; L. S. Shaw, Shaw Refractories, Inc., Cleveland; George Clarke, plastics research engineer, Owens-Illinois Glass Co., Toledo; and Dale Amos, vice-president, Amos Molded Plastics, Indianapolis.

The technical organization was previously set up with six basic committees in each section, with the chairman of each committee a member of the national committee covering the same subject. A. H. Voss, chief plastics engineer, Western Electric Co., Chicago, Illinois, and John Calef, Research Department, Automatic Electric Company, Chicago, Illinois, were chairman and vice-chairman, respectively, of the National Technical Activities Committee. The 1945 national program will include more serious and comprehensive technical work made possible by a new streamlined technical organization within the society. The cumbersome structure of complex sectional technical committees has been discarded and national professional activity groups are being set up for research, the development of standards and the general promotion of the scientific knowledge of plastics. The professional groups are appointing technical committees to serve until the completion of the projects assigned to them. These technical committees will appoint sub-committees where the need arises.

The finances of the society permitted the establishment of a paid office of secretary-treasurer in 1944. L. S. Shaw was appointed to fill this office. Lapel buttons, with colors distinguishing the regular, associate and junior memberships are a new feature.

The annual meeting at Detroit on December 5, 1944, marked the termination of the tenure of office of Charles C. Henry, president, and William B. Hoey, vice-president. Three new directors were inducted into office to replace the retiring officers.

Acceding to the request of the materials and trade groups, and in deference to O.D.T. wishes, the annual conference and exposition were postponed. The Chicago Section had supervision of this project for the Fall of 1944 and had the conference well organized in committees when that Section decided to drop it for the year. However, the society has plans for an annual national plastics engineers conference to be held in the Spring of 1945. Combined with this conference will be a large exhibit of materials and products. In 1943 this annual event took place at Detroit where 2300 persons attended a one-day session.

The vast expansion in the technical aspects of the industry indicates a definite need for an association wherein professional acquaintanceship, cooperation, and mutual aid will promote the successful expansion of the plastics industry while benefitting the individual members.

Engineers desiring to promote sectional organization should communicate with the secretary at 3269 Lansmere Road, Cleveland, Ohio.

Chas C Henry

A report from S.P.I.

GEO. K. SCRIBNER
president, S.P.I.

BUSINESS statistics show that it takes about 25 years for any new trade to become an industry. The plastics trade is certainly no exception to this pattern. In spite of our habit of extending our family tree back to John Hyatt and his discovery of cellulose nitrate plus camphor in 1868, we can really date today's version of plastics from Dr. Baekeland's taming of the reaction between phenol and formaldehyde in 1908. That birthday and 25 years would bring us to 1933, which would not be far wrong for the time when we emerged from the hot-dog stand category into a group of businesses that had an expanding future. Certainly all attempts to form a functioning trade association before that date, and there had been many, were sporadic and short lived.

Today's Society of the Plastics Industry, as a continuing organization, accepts 1937 for its birth year. Formed at first merely as an excuse to get the trade together and break down personal antagonisms, it has now developed into a powerful force competent of taking care of all the plastics industry's problems. The various bureaus and departments of the Government have found it irreplaceable as a rallying point of the industry's sentiment. Not only is it now accepted as representing the whole industry before outside organizations of all types, but it is also accepted by the industry itself as being capable of crystallizing the internal problems of its members. Its organization has the peculiar characteristic of being aristocratic because it is supported mainly by contributions from member companies, and democratic because it is run and officered by individual members of the society. Every effort is made to bring in new faces constantly to the management of the organization.

The permanent staff consists of an executive vice president, W. T. Cruse, and some eight assistants. Various subdepartments of endeavor have been set up, such as Technical and Engineering Data, Public Relations Trade Sections, V-Day Exhibition, Statistics, Accounting Procedure and the Washington Bureau, each headed by a capable man.

The Technical group is, perhaps, the most active at present. Under the leadership of W. J. McCortney and N. J. Rakas of the Chrysler Corporation Research Laboratories, well over a hundred members of the Society are building, through questionnaires and research, a comprehensive handbook of the industry. All of this material is being collated by the staff secretary who devotes his whole time to the task. First to appear was a complete classification of plastics and a scientific numbering system whereby all plastics could be ordered according to their engineering qualities instead of specifically by trade names. This system of classification is also being adopted by the Society of the Automotive Engineers, which has been in constant touch with its development from the very beginning.

Industry statistics are collected monthly, covering sales for various materials and methods of molding. Gradually a detailed set of financial reports is being compiled from some 50 companies, showing their operating statistics and financial statements from 1932 to date. Such statistics are made available only to the companies contributing. Too, in cooperation with the National Retail Dry Goods Association, S.P.I. is bringing out a simplified guide to plastics to make life easier for the retail sales people and is also compiling a similar guide book for distribution through its members to their customers.

Regular bulletins are sent out which at present summarize the most recent news from the Washington Bureau in official language, with supplementary explanations where they are needed. Various Government bureaus have freely admitted their indebtedness to this service in getting their rulings promptly to the trade, and getting, with equal promptness, the trade reactions to such rulings.

The constantly expanding office space on the 41st floor of 295 Madison Avenue, New York City, is a rallying point for all members who either have a few hours or moments to spare in that city or who have a problem to solve.

The future of the Society will rest on its constantly expanding usefulness to its member company and individual members. The development of a complete Handbook of Plastics for the working members of the industry involves the accumulation of data on material behavior through its life as a molded part, as well as the tolerances to which it can be made, its treatment in finishing, the design of inserts as well as pieces, the design of molds and the best materials for molds. There are countless facts we have yet to bring together for the trade itself. All of this will be the work of many years to come through the cooperation of many men. At the same time a group effort to get the buying public better acquainted with the individual plastics will keep another group busy. They must make sure that all plastics are not condemned for a misapplication of one. They must avoid the too glamorous tendency that has attached itself to plastics, substituting for that angle a feet-on-the-ground, practical attitude in the minds of the prospective buyers.

All of this and more require both money and organization, and it all must be done to assure a sane, profitable, continuing trade that may employ a comfortably large group of workers in all stations at comfortable wages.

Geo. K. Scribner

Plastics at war—Navy

The Washington Bureau of Modern Plastics Magazine, in cooperation with officials of the Navy and Army Departments who are specialists in the plastics field, reviews in the following four pages the outstanding applications of plastics in the equipment of the Armed Services of the United States which have been developed during the past year. Before publication, the articles were submitted for review and censorship to the proper authorities.

WHEN war struck the nation, plastics were not an unknown factor to the Navy. Our researchers had been carefully studying their possibilities for years and were aware of their utilitarian possibilities. But it is doubtful that any one person realized how important a part plastics materials could play for the Navy in World War II. Not only have they been employed to take the place of scarce materials in vital installations, but experts say that they frequently do a better job than the material they replace. In addition, many jobs have been found for plastics that no other material could do. For example, it has been estimated that a battleship contains around 50,000 plastic parts. Today plastics are being used only where they are particularly fitted for the job at hand, and we wish that even larger quantities were available. Unfortunately, it is impossible to relate some of their most important and interesting uses because we have no desire to tell the enemy why some of our devices are so extremely successful. However, we can say that two of the most valuable plastic applications are in component parts of rockets and electronic apparatus, and that admission alone should be enough to convince the layman of their indispensable value.

Among the most notable uses for plastics in the Navy is in wire and cable insulation. Ships of war, from battleships to submarines, are veritable power plants. The battleship "Iowa" alone is equipped with 900 motors, 816 telephones and 250 miles of heavy electric cable. The "Iowa" is an extreme example, but even landing ships carry sizable quantities of electrical equipment. It is quite obvious, therefore, that insulating material is needed in large quantities for operating the largest Navy in the world.

Several years before this war started, Navy engineers had become aware of the potential value of vinyls as insulation material primarily because of their flameproof, waterproof and dielectric qualities. Therefore, in so far as insulation for the Navy was concerned, there was no need for worry when natural rubber supplies were cut off, because plans were already under way to use vinyl. By 1944 the successful use of vinyl insulation had already been proved under fire.

Another practical use of vinyl has developed partially from the variety and brilliance of its colors. It is obviously impossible to string heavy and multiple cables all over a small landing craft. This handicap has been overcome by stringing light wire insulated with colored vinyl to designate the different circuits. The color makes it possible for repair men to know exactly which wires to follow and thus spot damage quickly without having to worry over the complexities of a multiple cable.

These same flameproof vinyl plastics, when used in ship upholstery and bedding bags, contribute to the prevention of that horrible nightmare feared by all sailors—fire. With cable covering, upholstery and bedding rolls made of fire retardant materials, the hazards of fire on shipboard are materially reduced.

Other valuable uses for vinyls have been as coating materials for the fabric used to construct the portable hangars which are moved from island to island as the Naval air arm advances its battle line. Large quantities are also used for pistol covers to protect the side arms of landing craft crews.

When recalling the uses of plastics for the Navy, particularly for insulation, it is especially interesting to note the amazing progress of polyethylene, which was just beginning to come into use by the Navy early in 1944. Its low power loss plus its toughness and ability to withstand extremes of temperature have made this plastic a superior material in the construction of high-frequency electrical equipment. Another use of this plastic is for gasket material in smoke tanks where chemical resistance is mandatory. Unfortunately many details on the part that polyethylene has played in helping to win the battle will have to wait until the war is over before they may be related.

The Navy has also sponsored and encouraged silicone resin production, which will get underway in a sizable quantity by the middle of 1945. This resin is used in the form of fluids, as a rubber-like substance and as insulation varnishes and greases. The latter are particularly adaptable for use on spark plugs in aircraft. Because of their dielectric qualities and ability to withstand high heat, silicones, when used as an insulator, make it possible for a small motor to do the work of a larger one or for the same size motor to do much more work without failure. When one recalls the number of motors used on a fighting ship, it requires little imagination to realize what a boon these silicones are to the Navy. Again, the rubber-like silicones are proving valuable as gaskets in supercharges and searchlights, where because of their high heat resistance they perform heavy duty under which other materials frequently broke down. As a fluid, they are added to hydraulic solutions to help maintain a constant viscosity under all extremes of temperature. Mention might be made here also of another plastic—acrylic polymer—which is also used for a similar purpose.

While on the subject of electrical apparatus and progress made during the past year, it is pertinent to mention another new plastic—polydichlorostyrene—which continues to be of increasing importance in molding parts for high-frequency electronics.

And, of course, there is the old standby—phenolic control boards which form an integral part of a ship's equipment. Some are as big as that of a powerhouse in a large city. During the past year there has been constant experimentation to improve upon the old board because of difficulties encountered

after continuous operation in humid climates. There have been trials with fabric-based phenolic, paper-based phenolic and the new melamine combination with glass fabric. The last mentioned has shown exceptionally good results, but it is possible that future experiments with silicones will improve even upon the accomplishments of melamine and glass.

It is of course impossible in this brief outline to tell about all the Navy items made of plastics which came into their own during the past year. Their use in the electrical field has been enlarged upon only because electricity is a dominant phase of Navy operations and plastics are playing an increasingly important rôle in that category.

A complete list of plastic items adopted by the Navy and put into full-scale use during the past year would fill several pages. In addition to hundreds of technical applications for ships and airplanes, there are such homely items as nonbreakable mess trays for plane and ship where they are subject to considerable pounding; a plastic whistle for sailors to use in case of distress; waterproof flashlight cases; hardware and drawer pulls; nameplates, badges, water tanks and wash basins; safety helmets for Seabees and even dummy pistols made in exact replica of the standard pistol for use in drill in simulated hand-to-hand fighting by aircraft crews.

One of the most interesting items is that of plastic screening for tents in tropical climates. Before the advent of plastics, it was found that screening then in use frequently deteriorated in a few weeks' time due to the humidity and other tropical nuisances. Both because screening material was scarce and because of danger from disease-bearing insects, the screen problem seemed to present insurmountable difficulties. But close cooperation between Navy laboratories and the plastics industry, plus the help received from new insect repellents, finally resulted in diminishing the damage.

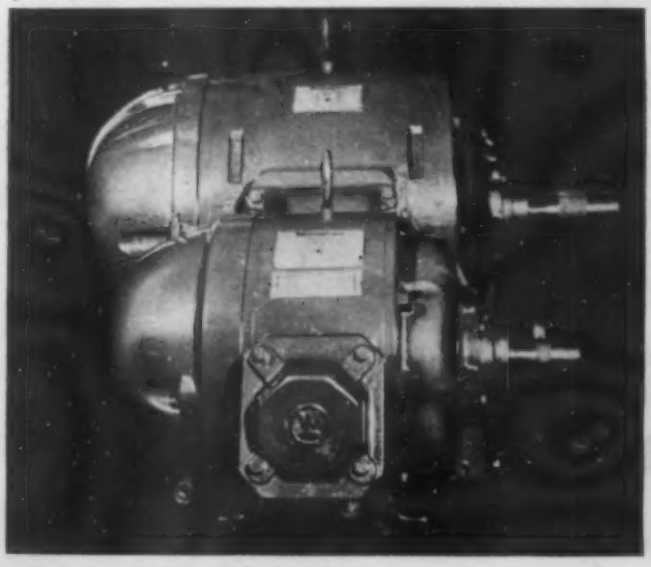
The Naval air arm, too, has found plenty of uses for plastics, with over 1000 parts reported in use on the larger planes. Then, of course, there is the well-known rescue boat which is dropped for stranded crews and the rescue equipment of each boat, which includes the desalting bag and hand pump among other plastic items.

Before closing, at least a word should be said about instruments. The industry is familiar enough with the surface lookout alidade, the pelorous driftsight and the many varieties of navigation and measuring instruments wherein plastics have been an important component because of their adaptability, readability and resistance to corrosion and various fungus spores. Many plastics' manufacturers have produced compass bowls and dials of all sizes. It is interesting to note here that the old binnacle stand which weighed over 200 pounds has been replaced by an all-plastic binnacle stand, which weighs 35 pounds and is standard equipment on landing ships where it is doubly valuable because the metal vehicles carried on these ships have little effect on the compass' accuracy. Perhaps the latest instrument to win favor (which we can talk about) is the all-plastic binocular with which the Navy has been experimenting for 12 years.

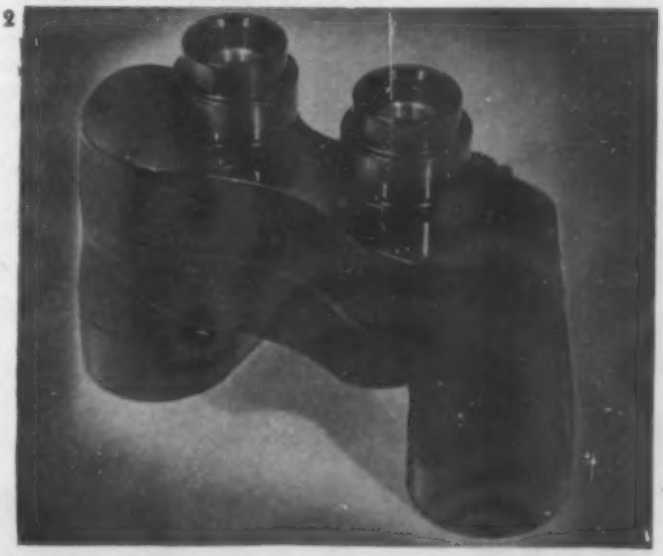
With the plastics industry continuing to provide new and better tools for the year ahead, the Navy will have more than a casual interest in the industry's continued progress. Perhaps the time is not too far away when all the details of items now listed as confidential can be given.

1—Use of silicone insulation makes it possible for the smaller of these two motors to increase its power output to 10 horsepower—equalling that of the large motor. 2—The new phenolic housing of the Navy 6 x 42 binoculars—the result of 12 years of experimentation—can be molded to extremely close tolerances. 3—Except for a metal center shaft, this Mark V surface lookout alidade is molded entirely of plastic materials

1 PHOTO, COURTESY WESTINGHOUSE ELEC. & MFG. CO.



PHOTO, COURTESY U. S. NAVAL OBSERVATORY 2



3 PHOTO, COURTESY BAKELITE CORP.

Plastics at war—Army

NO army would be capable of full-scale operation on enemy soil unless it received the necessary equipment and supplies. In World War II, the supplies needed by U. S. armies moved overseas, amount to five tons per man as against one ton per man in the last war; continuing maintenance requiring one ton per man per month. As the number of men overseas increases, so too does the amount of supplies, so that the Army Service Forces shipped a grand total of 40,000,000 tons of cargo overseas in 1944, compared with 19,000,000 tons in 1943. These supplies must not only reach our men in time, but they must reach them in a condition to be of immediate use. World War II has stretched the imagination and ingenuity of the best men we could muster to provide for the arrival of our supplies at the battlefront in a usable condition. For, it has been proved time and again that the packaging of military supplies is just as important as the supplies themselves. Early in the war we lost valuable time and tons of material when it became useless due to faulty packaging. Even today a brand new, but water-soaked battery would be of no more use in the Philippines than if it had never been shipped from the United States.

In reviewing the new uses for plastics over the past year, it is apparent that they have played an impressive rôle in this packaging program, and they are expected to play a continuingly important part in the tropicalization of equipment for use in the Pacific theater. In fact, the use of plastics for packaging is considered one of the greatest contributions that the industry has made to the Armed Services.

One of the first methods developed for packaging metal parts was a waterproof and moisture-vapor-proof wrap, in which one of the principal constituents is cellulose acetate film. But during the past year perhaps one of the most unusual developments has been the use of a hot plastic dip made from ethyl cellulose and other components. Metal parts are coated with this material, and when the item arrives at its destination it can be quickly peeled off. It not only saves a large percentage of the labor involved in the original packaging but also saves valuable time in preparing equipment for use when it reaches its destination. Another coating which proved its worth during the past year was a vinyl solution which was shot from spray guns like paint onto fighter airplanes loaded as deck cargo. The spray hardens in less than half an hour into a tough rubbery coating that protects the plane from rain, sleet or salt water, and strips off clean in big sheets, leaving a painted surface as immaculate as the day it left the factory.

Another protective covering used for military equipment and food is a moisture-vapor-proof barrier produced in combinations of fabric, paper and metal foil with a plastic heat-sealing medium. This particular material has been most helpful in protecting such things as food, radio, tank, automotive equipment, engine and motor parts. A close relative to this material is an aluminum foil laminated to a cellulose acetate film to help support it, and coated on the other side with a vinyl heat-sealing medium.

A plastic packaging job of more than casual interest is the saran moisture-vapor-proof barrier for machine guns used in aircraft. Formerly these guns were packed in grease, but when the planes were flying at high altitudes in low temperatures, grease particles hardened and sometimes caused gun failure. When saran wrap is used, it is a simple matter to strip it off—in contrast to the former grease removing job.

Probably the best known of the Army's packages is the famous V-Box, which was developed after complaints from the battlefront told of the losses incurred due to poorly boxed supplies. The box was developed more than a year ago, but during the past year it proved its full worth. A great part of its famed waterproof qualities can be attributed to the

PHOTO, WORLD WIDE PHOTOS

1

1—One of the most widely publicized applications of plastics by the Army is the transparent acrylic nose on such planes as this B-29 Superfortress. 2—A sizable percentage of the millions of M-52 trench mortar fuzes being turned out for Army Ordnance are molded of plastics. 3—These vinyl resin gun bags are so designed that they can be closed tightly by a simple knot

2

3

PHOTO, COURTESY CELANESE PLASTICS CORP.

urea and the melamine resins which are used in its makeup.

These examples are only a few of the many important ways in which plastics have helped in getting our fighting equipment to fighting men so that they can pick it up and use it without worry as to whether or not it will work. Such factors have been emphasized here because the Army is continually emphasizing the importance of getting material to its fighters in a usable condition.

Aside from packaging, plastics have been found to be a good work horse and can be used in all sorts of places. Even before 1944 everyone was familiar with the M-52 mortar shell fuze, which was the pride of the industry—and justly so—the millions of helmet liners used by our troops, raincoats, ponchos, ammunition components, and the usual timing gears, distributor heads and many other items used in automotive equipment.

During the past year many items have been added that are now in almost as general use as these older ones. Perhaps one of the most prosaic but nevertheless interesting is the thousands of tons of map paper made from melamine resin treated paper. It is impossible for the average person to realize how much map paper is used by the Army and how much of it was formerly destroyed or made useless by wet weather. However, this ingenious development of waterproofed map paper has relieved many an officer of untold map troubles.

The industry should also be complimented upon the rapidity with which it can go into action. Powder bags for artillery ammunition are an example. In the early part of the war large caliber powder was packaged in chip board containers. Under rough handling the metal ends of the containers frequently broke loose or the container was otherwise damaged. The contents were thus exposed to water when the containers were unloaded or stacked on beachheads. Some wise individual suggested a vinyl plastic bag which was placed inside the chip board container and kept the powder dry, regardless of damage to the outer container. This bag filled in admirably until steel containers for packaging the powder could be obtained. The remarkable part of this job was the rapidity with which it was accomplished. The first bag was turned out only thirty days after the application for facilities was placed with the WPB.

Vinyls also proved particularly valuable in serving as waterproof covers for small arms. They proved their worth when used on amphibious landings as protection against salt water, sand and mud. Later they proved useful in muddy foxholes when a soldier could clean his gun and slip it into the protective vinyl container with assurance that it would be ready for action when needed.

Even those outside the industry are well aware of the part played by plastics in communications, with their widespread applications in walkie-talkies, antenna masts, wire coating and such uses. The last year has seen increased use of a special lightweight assault wire coated with polyethylene or vinyl. With the new polyethylene insulated wire a man can talk over greater distances than ever before despite the worst possible weather conditions.

A new field in coated fabrics involves use of glass fabric coated with vinyl to produce flexible aircraft hangar doors and portable water tanks, as well as several other ingenious items which it is not propitious to announce at the time.

It would take a good sized catalog to list all the items from stencil brushes, combs, soap boxes, up to delicate instruments and bomber noses made from plastic, to say nothing of rocket components and automatic rifle stocks, but in this short space emphasis has been placed only upon a few representative items that have come into wide usage during the past year, with particular stress upon packaging because it was one of our most difficult problems when tons of material started moving overseas.

A word should be said about the individual aid given to soldiers through the use of plastics. In addition to its diverse uses in wearing apparel, perhaps one of the most interesting adaptations was the innersole for jungle boots which is made of several layers of plastic screen laminated together in such a manner that it will permit aeration inside the boot. In jungle fighting men frequently go for several days in deep mud with no chance to take off their footwear. Previously, their feet became infected, but the new ventilated innersole has measurably relieved that situation.

And last but not least, plastics are proving a great aid in the rehabilitation of wounded men. Plastic eyes, ears, noses and dentures, as well as laminated limbs, are making it possible for many a wounded man to move around without embarrassment in circles where he once feared he might be shunned because of unsightly wounds or missing members. In addition, plastics are being used in rehabilitation programs.

The still growing plastics industry has contributed its full share to war production. Its ingenuity has provided many items which the enemy has been unable to match despite the German's boasted superiority in the chemical field. It will continue to give all-out production until the enemy is thoroughly subdued.

WPB, Plastics Branch—1944

Military requirements for plastics at this time show increasingly larger demands which are interlocked with the general trend of the stepped-up military program. Also parallel to the war needs of plastics, only at faster tempo, is the fact that munitions and fuel require colossal quantities of chemicals which necessarily produce material shortages. Nevertheless, the simplification of procedure and greater freedom of distribution has been the aim of the Chemicals Bureau during 1944. Insofar as plastics orders are concerned, there have been various interruptions of this gradually unfolding program because of material shortages. But broadly speaking, the goal of our administrative officers is to make an orderly retreat from the civilian field while protecting the Armed Forces' interests as long as material is scarce.

The outstanding move in this direction was the issuance of Chemicals Order M-300 early in the year and the October 2 amendment to this order which is generally labeled in the trade as paragraph (f). Chemicals Order M-300 was devised following the advice of an industry-Government group on means of avoiding excess paper work and was designed to bring the various chemical orders under more uniform regulations. It is divided into three parts: legal, explanatory and a working table which gives pertinent data such as name of material, schedule number, filing date and the like.

The first plastics orders to be transferred to M-300 were M-260 (acrylics), M-170 (styrene and dichlorostyrene) and M-170-a (polystyrene and polydichlorostyrene). On last May 5 they were inserted as Schedules 17, 18 and 19. They were already in near-standard form and required little alteration. Since that time all plastics raw materials orders except phenolics, vinyl acetate monomer, vulcanized fibre and casein have been incorporated in M-300.

When M-300 was amended on October 2 by the incorporation of paragraph (f) it initiated a new method which may be used by administrative officials in allocating plastics and other chemical materials intended for civilian use. After all the necessary material has been set aside for the Armed Forces, the administrator may then authorize the supplier to ship the remainder of his production to any customer he chooses or may authorize specified quantities shipped to any customers provided it is used for a designated purpose.

Up to date only acetate, butyrate, urea and some vinyl types have been allocated by one of these methods. The urea authorization was later made impractical because of the formaldehyde shortage. But there is every prospect that other materials will come under this allocation method when Germany is defeated, if not before. Raw material supply is of course the controlling factor in the extent of control exercised.

Acetate and butyrate represent the gamut of tight and liberal control during the year. They started the year under the comparatively loose control or form 2947 (formerly PD-602) method, whereby the user notified only the supplier of his end use and the latter, when applying for his allocation, itemized all his various users' applications for each specific end use. Furthermore, scrap was not reported.

Wils Anderson Jr.

There was considerable dissatisfaction in the industry with the resulting allocations. Inflation on a grand scale had set in. As much as 20,000,000 lb. a month was requested when only 5,500,000 lb. were being produced. Criticism of inflated orders was followed by charges of loose control, unequal distribution and black markets. Consequently, a new order, M-326-b, was issued on February 23 and limited to molding powder only, including scrap. By the terms of this regulation officials were better able to scrutinize each order, prevent inventory build-up and spread the available material more evenly. By the end of 1944 the criticized evils had generally disappeared. Demand had shrunk to around 7,000,000 lb.; there was less talk of black markets, and allocations were operating smoothly. In the meantime it had been possible to remove scrap from the order when it was transferred to M-300 as Schedule 52 on September 16, and just recently acetate and butyrate have been placed back on the form 2947 method.

The latter step was made possible perhaps when paragraph (f) was adopted by the administrator on October 5 and all material for civilian use was turned back to the suppliers to distribute as they saw fit. The growing liberalization policy had been underway some time before this date under the Suppliers' Proposed Delivery Plan, whereby each supplier notified WPB of the amount he proposed to deliver to each customer for civilian purposes, based upon his monthly production, and it was automatically approved if there were no discrepancies. The supplier thus had greater leeway in determining which customers could obtain his goods. This method may prove more suitable than paragraph (f) in the further liberalization of plastics allocations.

The old urea and melamine order M-331 became Schedules 34 and 35 of M-300 on July 7. At that time it was considerably liberalized. Molding powder was separated from other ureas and administered under Schedule 34, and the small order exemption for molding powder was raised from 100 to 2000 pounds. Other ureas, adhesives and varnishes, received a small order exemption of 10,000 lb. in comparison to the former 1000. This order was later followed by the adoption of paragraph (f) for urea molding powder, whereby civilian production was turned back to the supplier for distribution as he determined, but as noted above, the recent formaldehyde shortage practically cancelled this arrangement. Civilian allocations of urea have been severely curtailed during the last two months because a great portion of the available formaldehyde needed for urea production has been allocated to war uses and there is no promise of relief until the war with Germany is ended.

Another type of liberalization practised by WPB went into force with the February 15 amendment to M-246, the phenolic order. This amendment offered a new departure in permitting the use, without specific authority, of 2000 lb. of (*Please turn to page 184*)

A new field for melamine

THROUGH a recently developed method of impregnating pigmented or printed paper and fabric surface sheets, and sections with melamine resins, laminates may now be produced in an ordinary hat-type press using a pressure of not more than 250 p.s.i. Because of the low-pressures involved—much lower than those commonly employed in the manufacture of laminated sections—exact reproductions of colored designs can be achieved without distortion of the patterns.

Though melamine resins have long been used in varnishes, it had heretofore been thought necessary to employ pressures ranging up to 2000 p.s.i. in laminate applications. Widely used in inlay decorative laminates, the resin is also incorporated into molding compounds in the manufacture of parts for electric installations where dielectric strength and resistance to arcing and tracking are important. An almost colorless liquid, melamine varnish gives a hard brilliant wear-resistant finish when subjected to heat and pressure—surface properties which continue to prevail under the new method of impregnation developed by the Detroit Wax Paper Co.

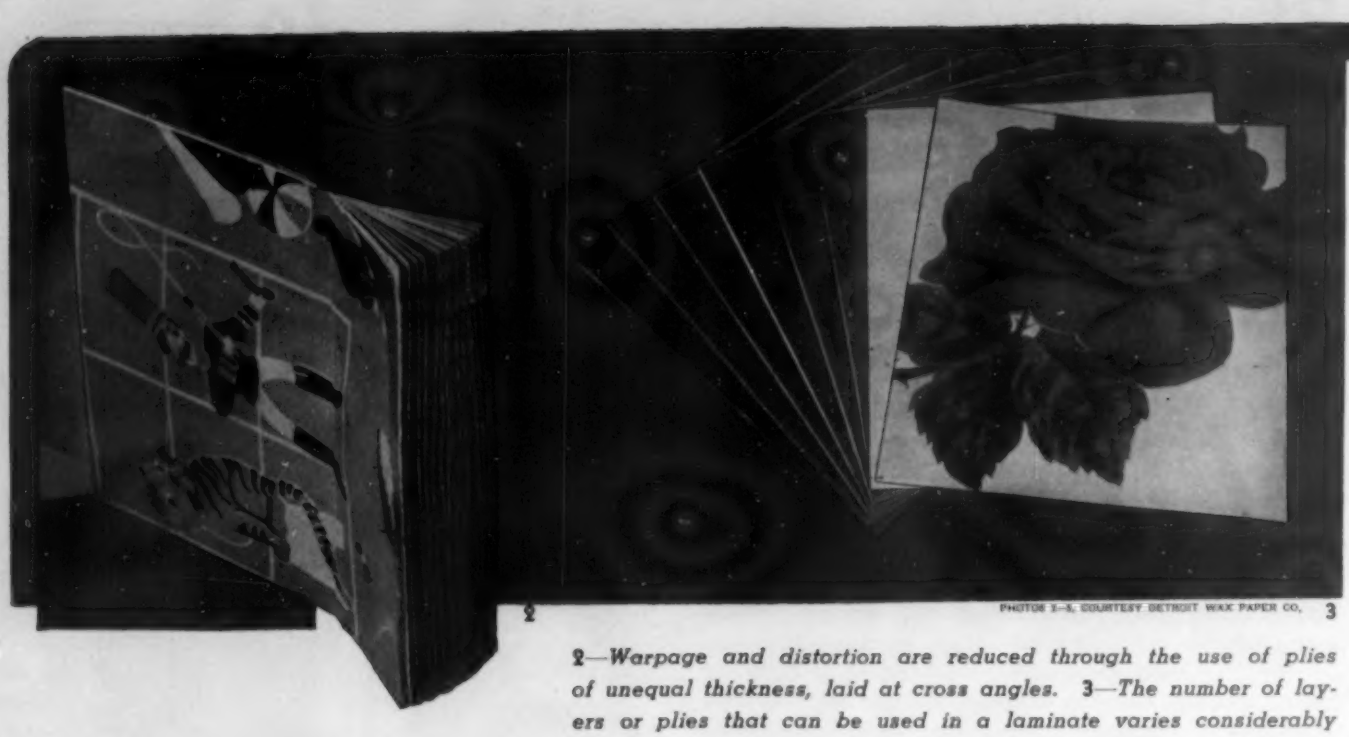
Fabric and paper treated by this method are found, after they have been pressed or molded, to have the characteristic surface properties of high-pressure melamine—resistance to abrasion and alkalis, low moisture absorption, general inertness in regard to odor and taste, over-all stability as well as the arc and heat resistance which obtains in molding compounds.

For this method of low-pressure lamination the melamine resin is used in the form of a varnish thinned to a consistency which makes it suitable for impregnation. In the process of impregnating the material, the untreated stock is passed through a bath of the varnish and then through squeeze rolls. The resin-impregnated material is then passed through drying ovens which evaporate the solvent in the varnish and partially polymerize the resin. Finally the treated material is rerolled for future uses.

The drying operation must be carefully regulated so as to leave the treated stock dry enough that layers of the material will not stick together when rolled up for storage, yet moist enough for proper lamination when subjected to pressing or molding operations. At present, details on the amount of resin used in this process, the time and temperature cycles are not available. However, it is known that the low-pressure feature of the treated material is obtained from the controls exercised at various stages in the impregnation process.

It is in the broadened limits for use of color and design at low-pressure levels that the impregnation of pigmented

1—A variety of melamine impregnated surface sheets were used for these 16 low-pressure laminated panels. Some of the squares were surfaced with material of a solid primary color while others had surfaces which included decorative designs ranging from Donald Duck patterns to a small-figured, multi-colored Paisley design. Additional color effects are obtained from the same designs through the use of different colored back-up layers



PHOTOS 2—3, COURTESY DETROIT WAX PAPER CO. 3

2—*Warpage and distortion are reduced through the use of plies of unequal thickness, laid at cross angles.* 3—*The number of layers or plies that can be used in a laminate varies considerably*

and printed surface sheets offers by far the most interesting possibilities. Instead of the homely, serviceable blacks, browns and neutrals or solid colors which have been associated with surfaces of industrial products made of melamine, the colors and shadings of the spectrum can now be achieved in whatever design is selected for the surfacing of the laminate. This widespread use of color carries with it the further advantage of exact reproduction of design and pattern in either single centralized figures or in a combination of figures.

Several sets of panels have been produced at the Detroit Wax Paper Co.—some surfaced with material of a solid primary color while others had surfaces which included decorative designs in a wide range of patterns from Donald Duck to a small-figured, multi-colored Paisley design. Line drawings and ink sketches also were impregnated and laid up for inclusion in laminated sections. After a series of experiments, all reproduced perfectly. They retained underneath the hard, marble-like surface of melamine, the exact lines and the precise shadings of color which the artist or designer had used originally (Fig. 1.)

It was possible to obtain additional color effects from the same design or pattern in the impregnated fabric through the use of different colored back-up layers or background sheets. With one background an over-sized blue rose appeared an entirely different flower than it did when it was presented against another colored background. This use of varying colors in backgrounds is of special interest in the manufacture of art objects or furniture in connection with decorative effects.

Production so far has been limited to panel or sheet sections, though there have been experiments in shallow draws as in serving trays, ash trays and like articles. The company intends to supply complete laminated sections on order in addition to providing melamine impregnation. At present, emphasis is centered on the production of melamine-treated fabric for low-pressure molding. The panels which are possible on the basis of experiments include surfaces on such base materials as plywood and phenolic impregnated kraft, laid up to individual specifications.

There is a singular freedom of choice in the material that can be selected for impregnation and subsequent lamination. The use of cloth with a close weave has been found to be best since such material has a greater basic strength and impregnates more satisfactorily.

Although there are, literally, no limitations on the color range which is possible in melamine-impregnated material, there are certain requirements in the colors themselves which must be observed. Fluorescent dyes and inks have been used experimentally with every promise of success in their application to melamine-impregnated paper or fabric. Commercially this will mean that light-glowing signs, directional arrows, clock faces, illuminated panel designs and many other serviceable and decorative applications will be available to the designer since the manufacture of these products is still in the low-pressure field.

To obtain the sharpest colors in the completed product it is advisable that the design be printed in sunfast dyes or dyes which have a pronounced resistance to ultraviolet rays. Otherwise, there is a tendency for the colors to fade and bleach out when the material used as the surface layer of the laminated section is subjected to the heat and pressure which are inevitable in laminating. This limitation on the types of dyes that should be used applies with equal force to the material for the underlay layer or background sheet. Off-color or uneven color in this sheet will destroy the effectiveness of the design as much as a blur in the surface sheet itself.

It is also advisable that the dyes be tub-fast since distortion in the color or design while the material is in the liquid bath during impregnation would destroy the value of the print by the time it was ready for laminating. The inks used in the printing of these materials are restricted to those not having a linseed oil base. Oil content in inks makes them run, blister or blur when subjected to the heat and pressure of the laminating process.

Given a sunfast dye or ink, the process of impregnating the fabric or paper surface sheet on which intricate designs have been printed is substantially the same as that followed in the impregnation of materials having solid colors. The quality of the ink or dye rather than the method of printing determines the degree of effectiveness which will obtain when the impregnated cloth finally has been molded into a laminated section. It is important to use printed material for impregnation where the press register is exact since the design and color will be preserved as it is in the finished surface.

One of the major considerations in the use of this low-pressure method for laminating melamine-impregnated sections is the lower production cost. Not only are significant savings in labor and materials claimed for the new process in comparison with high-pressure laminations, but the use of lighter machinery—a simple hot-type press—makes possible a certain flexibility in operation. In addition, the fabricator claims that the actual operating, maintenance and processing costs are markedly reduced.

Paper and fabric impregnated by this company have been successfully processed into laminated sections in a heating cycle of 12 to 15 min., at a pressure of no more than 250 p.s.i. This compares with a time cycle of 25 to 30 min. and pressures of from 800 to 2000 p.s.i. which were formerly required for a $^1/_{16}$ in. section of melamine laminate. The improvements in the new process in both time and pressure requirements were achieved without change of the curing temperature—which was 285° F.

The completed panels may be of any desired thickness though established factors regarding distortion and warpage apply here as they do in other laminate operations. That is, warpage and distortion are reduced through the use of plies of unequal thickness, laid up at cross angles. In experiments with the molding of melamine-impregnated surface material on laminated sections, distortion was such as to cause concern. Further work on this problem indicated that curvature in the final product was negligible if a balanced construction were employed in which similar or identical sheets were used on both sides of the core. In an unbalanced assembly, warpage occurs because of a difference in the shrinkage characteristics of the surface materials.

Though the stock or foundation sections require only ordinary care in the lay-up procedure, the surface section must register exactly, particularly when the material is employed for a molded shape. This means that the cloth must be placed exactly in the mold cavity.

Experiments which have been carried on thus far indicate that there is literally no limit to the thickness of sections having a melamine-impregnated ply for a surface layer. Panels ranging from $^1/_4$ in. to $1^1/_2$ in. in thickness are in common use although decorative laminates are seldom as thick as this. The number of plies or layers which go to make up the completed section range from 2 to as many as 14 in the case of some panels which are made entirely of cloth. It is normal practice to use a barrier sheet to prevent the dark core resin from bleeding through.

Of particular interest to those interested in the manufacture of furniture is the fact that it is possible to obtain melamine-surfaced panels of the same dimensions as ordinary plywood sections now in commercial production. This freedom from dimensional restrictions also means that large panels can be produced without affecting in any way the color or design of the material used in the surface layer.

Experiments have been made in the molding of die-cut material. In this manner, items can be produced with sharp angles or deep draws. Where impregnated material has not been die-cut, the depth of the draw and the sharpness of the angle in the completed product have been limited since the stretch limit of the fibers in the basic material is not improved by impregnation. In (*Please turn to page 182*)

4—In the process of impregnating the decorative surface sheet cloth, the untreated stock is passed through a bath of varnish and then through squeeze rolls. 5—After being passed through drying ovens the resin-coated decorative fabric is ready to be cut into sheets for panel lay-up, or it can be rolled up for future use

4

5

REDESIGNING FOR THE FUTURE

IN the small community of Plymouth, in northern Indiana, officials of a concern that was virtually unknown nationally in prewar years are putting the finishing touches on an ambitious program designed to capture a sizable share of the postwar radio market. Already a plan has been worked out for selling entirely through radio parts jobbers—something of a departure in the industry. Designs have been completed on a full line of radios, phonographs, loudspeaker systems and other undisclosed products of a similar nature. And in all these designs, plastics will play a leading role.

The company is John Meck Industries. Three of the new Meck postwar products to be plastics-made are shown in the accompanying illustrations—a table model radio with a novel new dial arrangement, a table model portable phonograph with an "acoustically corrected tone chamber" and a three-piece portable public address system consisting of an amplifier and two loudspeakers.

These products have reached the stage where the company will shortly be ready to make the dies—at least for the radio and phonograph which will be compression molded of a phenolic material. The completed units may either be painted or left with the natural color of the plastic material. It is possible that the public address system will be made of a low-pressure laminate. All three products were designed by Barnes & Reinecke, industrial designers and engineers, who have been working on the project since last spring.

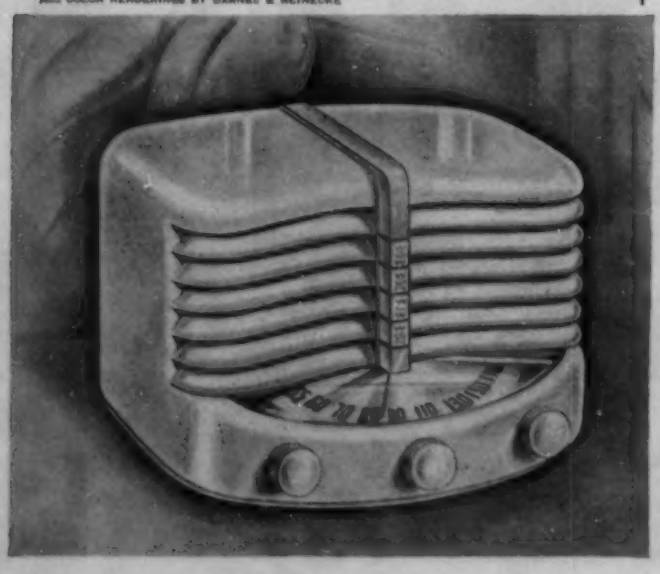
Portable and table model radios

Believing that most portable and table model radios are sold primarily on the basis of eye appeal, especially when women are the purchasers, both the manufacturer and the designers worked toward "something different" in radio design. The result is a machine (Fig. 1) in which the dial with its large and easily visible figures and calibrations, is positioned

1—In designing this table model radio, both the manufacturer and the designer worked to achieve "something different" in the belief that most units of this type are sold on the basis of eye appeal. The dial is positioned in a horizontal plane and projects out in front of the cabinet. 2—A different design in the tone chamber is a feature of this postwar phonograph model which operates with the radio—using the radio's speaker

ALL COLOR RENDERINGS BY BARNES & REINECKE

1



2

on a horizontal plane and projects out in front of the cabinet so that the radio can be used either on a table or deck or on a low bookstand—perhaps beside a chair. A transparent cellulose acetate cover is contemplated for this dial, which will of course be lighted. Manual control knobs are located in the lower front, around the semi-circle of the dial housing, while push button controls are placed in a vertical row above the dial in the center of the cabinet front.

The cabinet of this radio will be in one piece except for the dial covering, the manual control knobs and the push button controls. A wide range of models will be produced to retail at $14.95 to $69.95—the highest priced unit having FM reception. The particular model shown in Fig. 1 is approximately 12 in. wide, 7 in. deep and 8 in. high.

The portable phonograph (Fig. 2) is distinctive in that the proportion of depth to width, or diameter, is far less than is usual in units of this kind. This reduction was made possible by a different design in the tone chamber. While dimensions of this unit have not been released, they are not difficult to approximate since a 12-in. record can be accommodated on the machine. This cabinet, like that of the radio, is in one piece, even including the recessed decorative panel in front. The unit operates in conjunction with a radio set—utilizing the radio's speaker. The needle arm also will be in plastic, and it is planned to present the complete product in two colors, red and white.

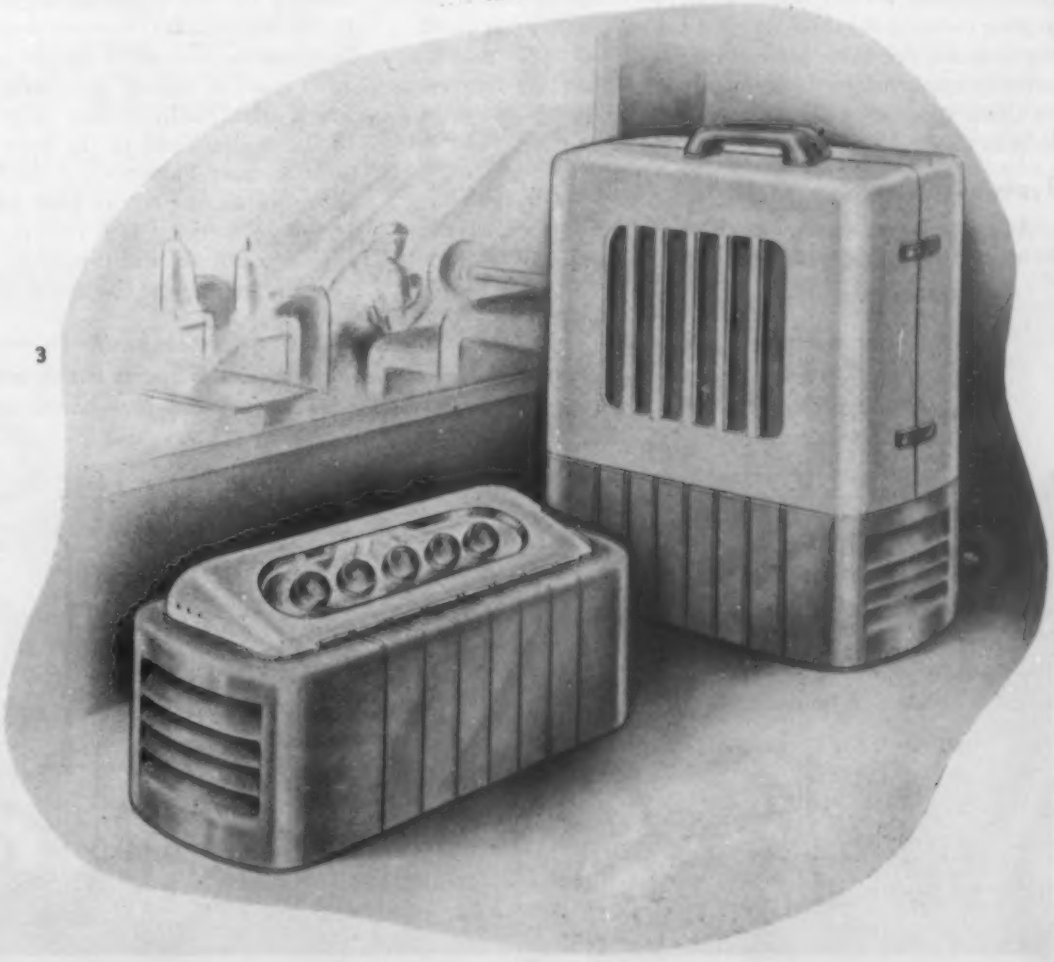
Interoffice communications

Interesting as they are from a design standpoint, the radio and phonograph are not perhaps as ingenious as the loudspeaker set shown in Fig. 3. The complete assembly consists of two loudspeakers and the amplifier, which is shown separately at the left of the illustration and as the lower section of the portable unit at the right. The system is so designed that it may be set up permanently or carried about. For carrying, the two speakers are placed back to back and fastened together (left Fig. 3). In use, the speakers may be placed separately, either in two locations in a large room or in separate rooms, depending upon the use to which the equipment is to be applied.

The amplifier case is approximately 20 in. wide, 10 in. deep and 10 in. high; each speaker is about 5 in. deep and 14 in. high. Thus, the entire assembly has over-all dimensions approximating 20 in. in width, 10 in. in depth and 24 in. in height. The microphone connection and other wiring attachments are in the back of the amplifier case. It is possible that the design may be altered to some extent to permit inclusion of a microphone in the system. However, as the unit is made up at present the microphone must be carried separately from the speaker and the amplifier case.

While present indications are that low-pressure laminates may be used throughout this set, it may be that the amplifier case will be compression molded. In all probability the company will make use of stock plastic handles for all the dials on the various component parts of this machine.

John Meck Industries made its start in Chicago about 5 years before the war, merchandising loudspeaker systems. During the war, however, the major portion of the company's activities has been concentrated on the production of quartz crystals used in short wave radios and in a wide variety of other secret electronic devices for both military and naval communication.



3—*According to present plans, this postwar loudspeaker system will consist of two loudspeakers and the amplifier. The amplifier is shown separately at the left and as the lower section of the portable unit at the far right*

An Education in Plastics

by J. C. LOUER*

BECAUSE plastics do not grow in the ground or come to man readymade, there is a seeming mystery of origin that arouses a desire in the uninitiated to learn how these materials are made. In this group are numbered quite a few students. Without any particular use to make of what they learn, these students believe that plastics have a great future and, consequently, wish to understand them much as one understands a magnetic compass, the electrolysis of water, or the cracking of petroleum. For their purpose a minimum of technical words, a maximum of color motion pictures and a liberal amount of futuristic thinking about what may be—if and when—will be all the educational training that is necessary.

A second group with an interest in plastics is made up of artists, designers, advertising men, lawyers, accountants and others whose business is not directly concerned with these materials but who are interested in them as a potential contact. In this instance, the concern is largely with vocabulary, broad general areas of the industry, the finished product and its paper work rather than the specific techniques of molding, finishing, inspection and similar operations.

There is also a third group whose members are not so easy to classify as to *origin* since they may be factory laborers, toolmakers, chemists, electrical engineers or so-called efficiency experts. Their origin, however, is not so important as their common *objective*—to learn as much as they can about the technical side of the plastics industry. Only a few may be actively employed in the industry, but somewhere they see or think they see a place where such knowledge will be of help to them.

Types of courses

As might be anticipated from a survey of this wide range of interests, it would be difficult if not impossible to bring together in one course all the information desired by all three groups. To meet in full these diverse needs, series of courses should be worked out, each with a different development of content. A popular short course with a liberal sprinkling of educational films to supplement the talks might serve the first group. No attempt would be made to become technical, nothing would be said about tensile strength or creep—the audience would come largely for entertainment.

For the art group, plastics would be developed as materials for expression, ranging from hand-formed methyl methacrylate candelabras to injection- or compression-molded building hardware. Nor need creation stop there. A survey of architectural, sacramental and display applications would reveal enough work for many weeks of profitable study. At its best, such a course should include enough engineering so that those who attend will be able to take advantage of the best characteristics of materials or processes and to know the pitfalls that must be avoided. If shop fabricating or experiments could be included, so much the better for in this way the students will get a picture of all sides of the industry.

Business executives in the plastics industry can, as a whole, be divided into two groups—those who have had business experience in other fields, and those who have worked up through the sales, production or engineering departments. In the first instance, business training acquired along general lines has been adapted to the plastics field. But for the other group of business men there has been little information which would facilitate their switch-over from the production to the business end of the work. To offset this handicap both MODERN PLASTICS and the Society of Plastics Industry have, within the recent past, made studies and published findings concerning such vital problems as costs, profit, loss, inventory control and personnel. This trend may lead to a demand for courses, conducted by properly qualified leaders

* Elmer E. Mills Corp.

1—For the student who wishes to understand more about plastics because he believes they have a great future but has no particular use to make of what he learns, a course with a maximum of color motion pictures and a minimum of words—no technical data whatsoever—is highly recommended

devoted entirely to the business problems of the plastics industry. At the present time the best solution would probably be a survey course offered along semi-popular lines in which the business trained individual could become acquainted with the general plastics vocabulary, the materials and the processes. Whether or not he decides to make that business training work for better plastics will be determined by factors outside the course outline.

Following this general survey, a limited number of technically inclined individuals may desire specialized study in some particular field of the industry. Several types of courses have been developed to meet this need so that today plastics may be studied by correspondence, by attending evening classes or by full-time residential college work. These classes may be further subdivided into the "trade or vocational school" type where a representative set of plastics machines are used to supplement the oral instruction; the forum-type of semi-formal discussion based upon text material under professional leadership; and the conventional college course which is either a part of the regular curriculum or of the Engineering, Science and Management War Training Program of the Federal Government. One Midwestern university, Northwestern University to be exact, has advanced courses in at least two fields of plastics materials and others may be added when the demand justifies such a move.

Government courses are offered to individual industrial plants where they are conducted under company sponsorship either during the working day or after hours. This type of instruction serves a specialized need and can be confined to subject matter of an "on the job" nature. Costs range from several hundred dollars to the privilege of attending regular courses without even buying a textbook.

Teaching personnel

Announcement of a new course in plastics is the signal for persons in every walk of life to inquire about registration. The charging of tuition eliminates the casual individual who is not sufficiently interested to be willing to pay for the privilege of attending class. In the case of tuition free courses, other means of selection are usually devised—prerequisites in engineering or chemistry, employment status, or tangible evidence of a serious desire to learn about plastics. By any of these standards there will still be some who discover after a few lessons that plastics are not miracle materials but substances brought forth by hard work which share the natural limitations common to other engineering materials.

On the whole, it has been more of a problem to secure teachers than students. There are many who want to know about plastics—few who are qualified to teach a balanced course covering the entire subject. This situation is due to two factors. The literature on plastics is somewhat limited—less so today than five years ago but still restricted in comparison with some of the older fields. Secondly, many of the best informed members of the plastics industry have come by a large part of their knowledge by the trial and error method, the rule of thumb procedure plus a liberal amount of personal judgment. These men were trail blazers and as such had to chart their progress as they made it. When they were starting, one could not find in any store or library the information which is available today for the asking. In the early days, trade practice was not discussed outside of the plant—and with good reason. John Royle who built some of the first rubber extruders reveals in his autobiography that for several years he built machine after machine and never was permitted to see one in operation!

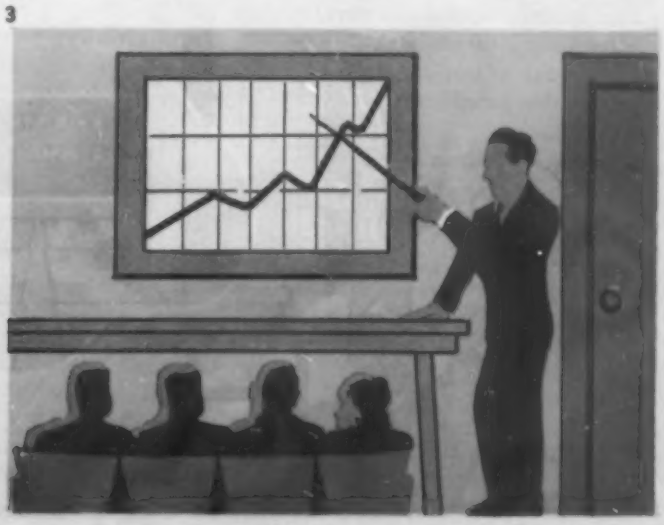
Today there is a growing realization that only by sharing certain technical knowledge can the industry as a whole present its story to those who ultimately purchase its products. Within the last few years various books have been published in which a technical man outside the industry can find the kind of plastics information that will enable him at least to estimate the applications in which plastics may serve him to advantage. The growth of the PLASTICS CATALOG is another illustration of this awakening.

The war has focused attention on plastics, and a cry has gone up for teachers who *know* plastics. You can without much study understand the problem facing a new teacher—new at teaching though a veteran perhaps in some practical phase of the plastics industry. A broad outline calls for lectures on several subjects outside his personal experience. The toolmaker has little background in chemistry, the chemist is seldom familiar with molding machines and the molder may have little acquaintance with costs or paper work. Probably none could discuss priorities and allocations procedure. Regardless of the group from which the instructor is selected there will be areas of the subject which will be pure theory for

***2**—For the artist and advertising man who are interested in plastics as a potential contact, courses should show the variety of objects that can be made from these materials.* **3**—*The business executives are interested in courses which indicate how they can adapt general business practices to this special field*

2

3



him. There may be students in the class whose daily work has made them specialists in the very thing about which the instructor knows the least.

The second problem in working out a course of instruction is that of organizing many years of reading and daily work into a form which is suitable for the group receiving the instruction. Most of the instructors have a full daily schedule, many are working overtime despite the added burden of teaching. As a group, few need the extra income in the sense of the professional full-time teacher. For many the acceptance of such a class represents a cheerful added effort in the interests of a coming generation.

We have then a unique situation—a popular group of engineering materials, a body of students from widely diversified walks of life seeking specific technical or vocational help, and a limited teaching staff taken largely from industry, many with no previous experience or preparation for teaching. In the days ahead we may expect better and better solutions to this problem through increased use of visual education materials, greater standardization of curricula, and the development of a group of professionally trained educators who can give their full time to teaching instead of evenings at the end of a strenuous working day. It should be noted, however, that in spite of present handicaps many successful courses have been taught and the students who have taken them are doing vital work in the industry today.

Purpose of plastics courses

A word is in order as to the purpose of these vocational courses apart from the knowledge to be gained about plastics. Except for full-time residence courses requiring a year or more for completion, there is a definite limit on what can be accomplished. A doctor spends 7 or 8 years in classroom study and then goes on to serve an interneship in a hospital. A standard engineering degree requires several years of residence study. It is therefore impossible to expect even a superior student in a course of 10 to 16 weeks' duration with only 3 or 4 hours of classwork a week to gain the equivalent of an engineering training in plastics. This limitation is mentioned here because personnel interviewers are repeatedly faced with students who have taken such courses and feel that they are thereby entitled to a special job either as a designer, a sales engineer or a foreman.

These courses cannot transform a high school student or a bricklayer into a plastics expert in 16 weeks. But they can do a number of things for the serious student that he can not readily do for himself. For the individual who intends to get the most out of his time in the industry, a foundation course of "book knowledge" is well worth the college tuition.

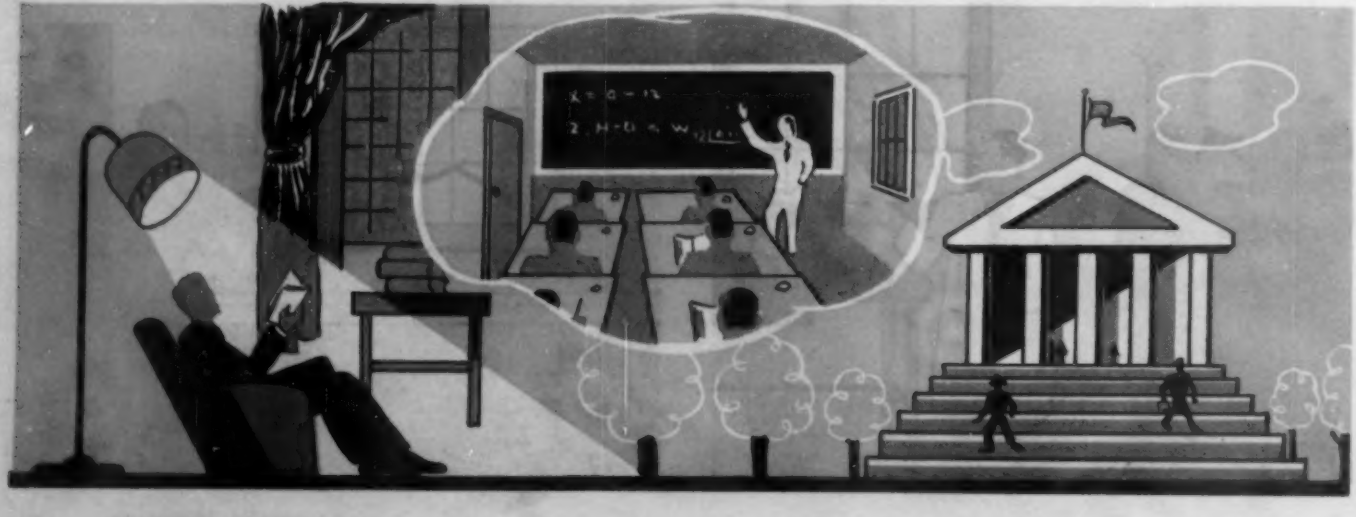
Specifically, these courses are intended to introduce new personnel to the industry and to orient prospective workers in their fields. They should help employed personnel to get an over-all grasp of the industry and its relationship to their particular job, to review the nature of plastic materials, their processing and applications and to acquire an understanding of the vocabulary of plastics. If a student can obtain these immediate objectives and get acquainted with the literature of the field, he will have within his grasp the ladder that will help him climb. Experience, which may have to come the hard way, will be a part of that climb; but he will be spared many needless steps. Obviously the higher a student is when he starts actual work in a plastics plant, the greater will be his ultimate opportunities. Thus, a graduate mechanical or chemical engineer may in 2 or 3 years be doing successful independent engineering work.

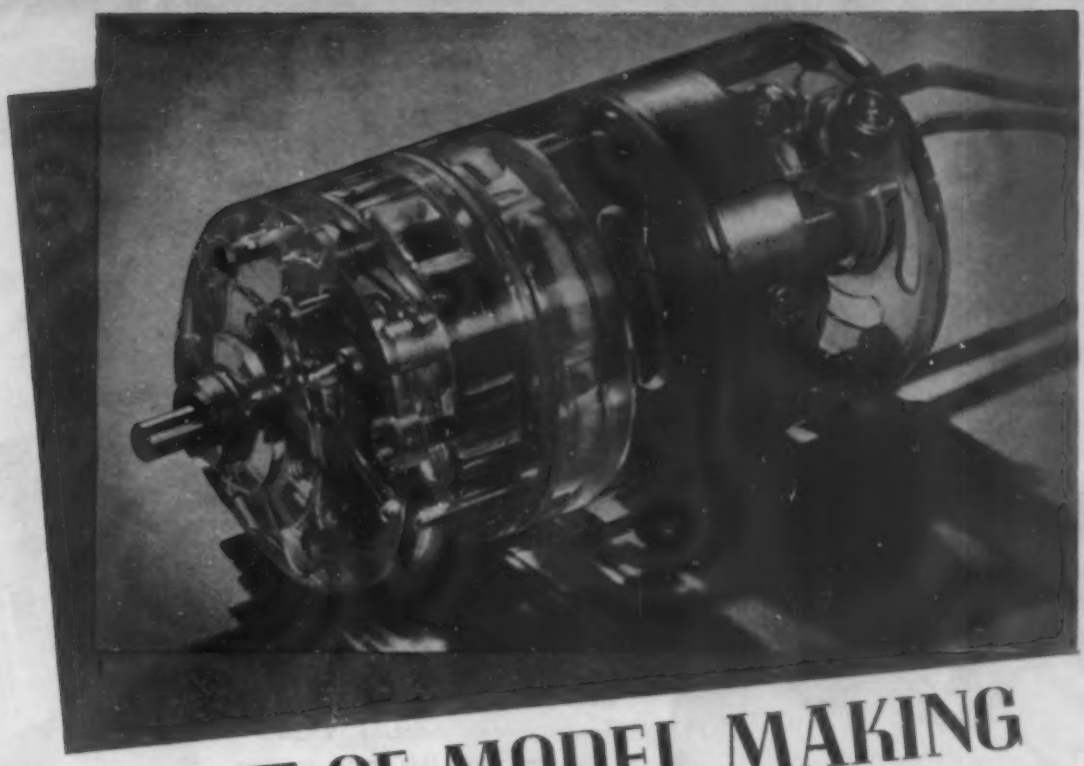
Choice of proper course

The question sometimes arises as to the possibility of getting as much from reading books and technical magazines as from going to school. There is no single answer; but this suggestion may be of help. After a survey course for orientation—an opportunity to study the road maps of the journey ahead—the mature student may be able to travel the journey alone. It will not be easy. There is no schedule requiring an assignment to be completed at a fixed time. Only by vigorous application will the study continue, week after week, month after month. Some have that inner drive to keep going. For others, the discipline of a classroom and a coming examination together with the friendship and inspiration of a competent instructor will help them over the more difficult stages of getting established in a new field. For each, the ultimate test is not in the classroom but in their ultimate success in industry. Therefore, before he essays his first step into the realm of plastics, each person must decide exactly what he wishes to gain from his study and plan according to his best interests.

4—Several types of courses have been developed to meet the varying needs of those interested in plastics. There are correspondence schools, trade or vocational schools wherein many of the courses are given at night, and full-time college courses which are frequently part of the regular curriculum

4





ALL PHOTOS, COURTESY
A. STEVEN LEWIS ASSOCIATES

THE FINE ART OF MODEL MAKING

TODAY, the making of models and miniatures is becoming one of the fine arts of plastics. Serving many fields and meeting a variety of requirements, plastic models fall into numerous classifications—principally under the headings of display, education, technical, experimental and pre-production. And there are, in addition, models which are used for the styling of a product, and others which are fashioned for the fastidious few who want "something different."

Then, too, plastic models are coming, more and more, to serve a combination of needs. For example, a certain soap maker wanted a new plastic dispenser, and he ordered models chiefly for style and design purposes. However, previous experiments had shown the soap to contain an ingredient which caused certain plastics to swell. Manufacturers' charts of the properties of their materials either had been found inadequate or did not set forth the required information. So while the model maker was designing for style, the soap maker was testing the plastic materials for use with the particular soap in question.

In another instance, a manufacturer ordered polystyrene models of a new type coffee dispenser for the combined purposes of testing the action of the device, experimenting with its appearance and discovering the abrasive action of the coffee as it might affect the dispenser mechanism.

The activities of one model maker, A. Steven Lewis Associates, disclose other interesting examples of uses and applications of all-plastic miniatures. One manufacturer of fractional-horsepower electric motors for aircraft wanted a display model of one of his latest units. That is, he wanted a display insofar as the housing was concerned. But inside there was to be a motor that actually operated. The main purpose of the model was to allow the full action of this motor to be observed in detail. This involved an exact duplication in methyl methacrylate of the metal housing of the production unit.

Swinging to the other end of the scale of model needs was another custom order for what probably should not be termed a model at all, though the same technique was used. A prominent Chicago dentist ordered a special base for desk fountain pens to be produced to exact specifications as a really fine gift for a colleague in St. Louis. Not liking the glass pen accessories on sale in the stores—thinking them too small and too light—this dentist specified a pen base that was both larger and heavier, and embellished with gold.

Many new ideas in merchandising likewise are being tested through the use of plastic models. One of the most ingenious was a nest of three (more could be used) cellulose acetate food containers, triangular in shape and sized to hold pieces of pie, generous helpings of salad or other food. A requirement here was that the fit between top and bottom be so tight that the containers could be carried in a man's coat pocket or woman's purse. When empty, the containers fit, one within the other, to save space.

According to recent operations at A. Steven Lewis Associates, it is evident that various types of available plastics are being used—transparent methyl methacrylate for display and educational models, cellulose acetate for pre-production types, and phenolic resins for certain types of handles as well as for test models of electrical appliances.

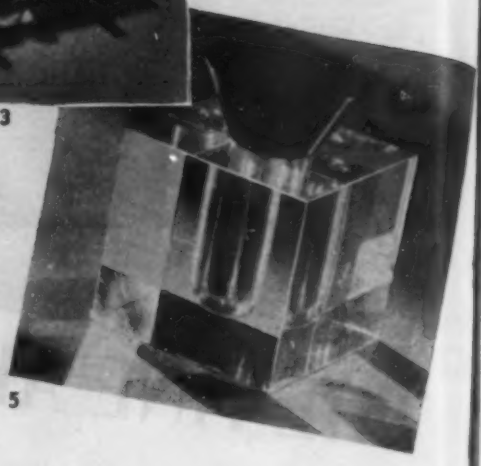
Examples of the models which have been made from plastics are shown on the two following pages. The variety of applications and the intricate designs possible are fully evident here.

Credits—Material: Lucite for motor housing, pen base, dressing table accessories and base of cosmetic container; Tenite for food containers, humidifier, make-up container, dressing table accessories, flashlight housing, stopper of cosmetic container; Plexiglas for air duct; Lumarith for goggles. Coffee dispenser, Club Aluminum Products; Motor housing, National Mineral Co.; Food containers, Pie-O-Pac Co.; Humidifier, Cloverleaf Plastics Co.; Make-up container and flashlight housing, Norton Laboratories Inc.; Dressing table accessories, Associated Distributors; Jewelry cases, Montgomery Ward & Co.; Air duct, Armour Research Laboratories; Goggles, Sillstron Mfg. Co. All models by A. Steven Lewis Associates.

2

3

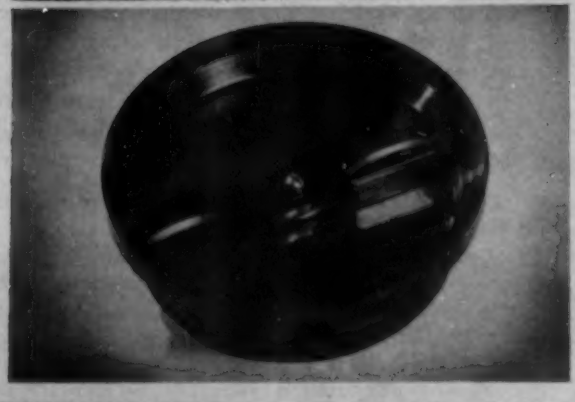
4



5

1—By duplicating the metal housing of a motor in transparent plastic, one company makes it possible for buyers to see the inner workings of the machine. **2** *and* **3**—*One section of this same housing and a gear mounting.* **4**—*The technique employed in making a part to order—this desk fixture, for example—is the same as that used for models.* **5**—*Containers for an exclusive cosmetic line were first tested through the use of models*

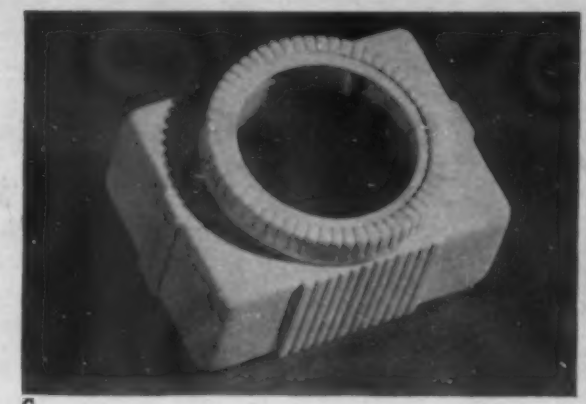
6



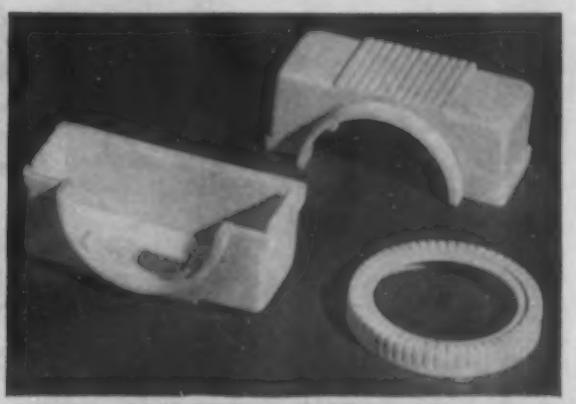
7

8

6—To demonstrate the principle behind one method of removing dust from internal combustion engines, an experimental transparent model was built. Dust-laden air is circulated in the U-shaped innerchannel, after being introduced through hose lines attached to studs. The model base is a solid sheet of plastic in which two openings have been cut. **7** *and* **8**—*Five parts comprise this test model of a coffee dispenser for large homes or restaurants. A large coffee can fits over the top*



9



10

11

9 and 10—A 3-piece model of a flashlight housing was constructed of cellulose acetate butyrate—the test parts exactly duplicating the molded pieces that make up the completed unit. **11**—*In the field of fine jewelry and cosmetics, transparent plastic models are being used to advantage. When these ring boxes are covered with a half circle of transparent material instead of the flat covers shown in this illustration, they make excellent display cases for jewelry*

12

12—Recently, a small experimental model of a cake or ice box humidifier was fashioned in the shape of a baker. **13**—*These models of food containers were shaped to hold a piece of pie or other food.* **14**—*Cosmetic firms often order pre-production models of new containers. An example is this pancake make-up box.* **15**—*This pre-production model of industrial goggles was constructed from drawings, then shaped to fit the average head*

15

13

14

Plastics on Review

1 With this attractive shampoo container continually before the eye on the cosmetics shelf, it should be an easy matter to keep the hair in shining condition. Designed by P. A. Derham, Rosemont, Pa., for M. Louis Products Co., both the egg-shaped container and the stand are injection molded of Lumarith by Universal Plastics Corp.

2 The temporary office of an Army dentist in an outlying military post must be equally as efficient as his civilian office, even though it cannot be quite so elaborate. Such items, therefore, as these Army portable x-ray units employ uniform-density Plaskon cones manufactured by Picker X-Ray Corp. to eliminate objectionable images and insure the accuracy of the x-ray. Since the cone comes into close proximity with the soldier's face, its smooth, high luster as well as the fact that it remains clean, bright and sanitary were contributing factors in its selection for this purpose

3 Where temperature variations occur frequently, as in the case of automotive ignition parts—distributors, rotors, coil tops, etc.—a material must be employed which has a very low mold-shrinkage factor. Durez Plastics and Chemicals, Inc., have specially formulated Durez natural, a phenolic molding compound which is particularly adaptable for this use, especially in those parts which require metal inserts, since it is said to reduce stress around the inserts while providing a strong, durable body for the parts

4 The problem of loading and unloading the transport planes of Pennsylvania Central Airlines without causing serious damage to the fuselage has been solved by the lining of the cargo space with resin-impregnated Fiberglas sheets. Manu-

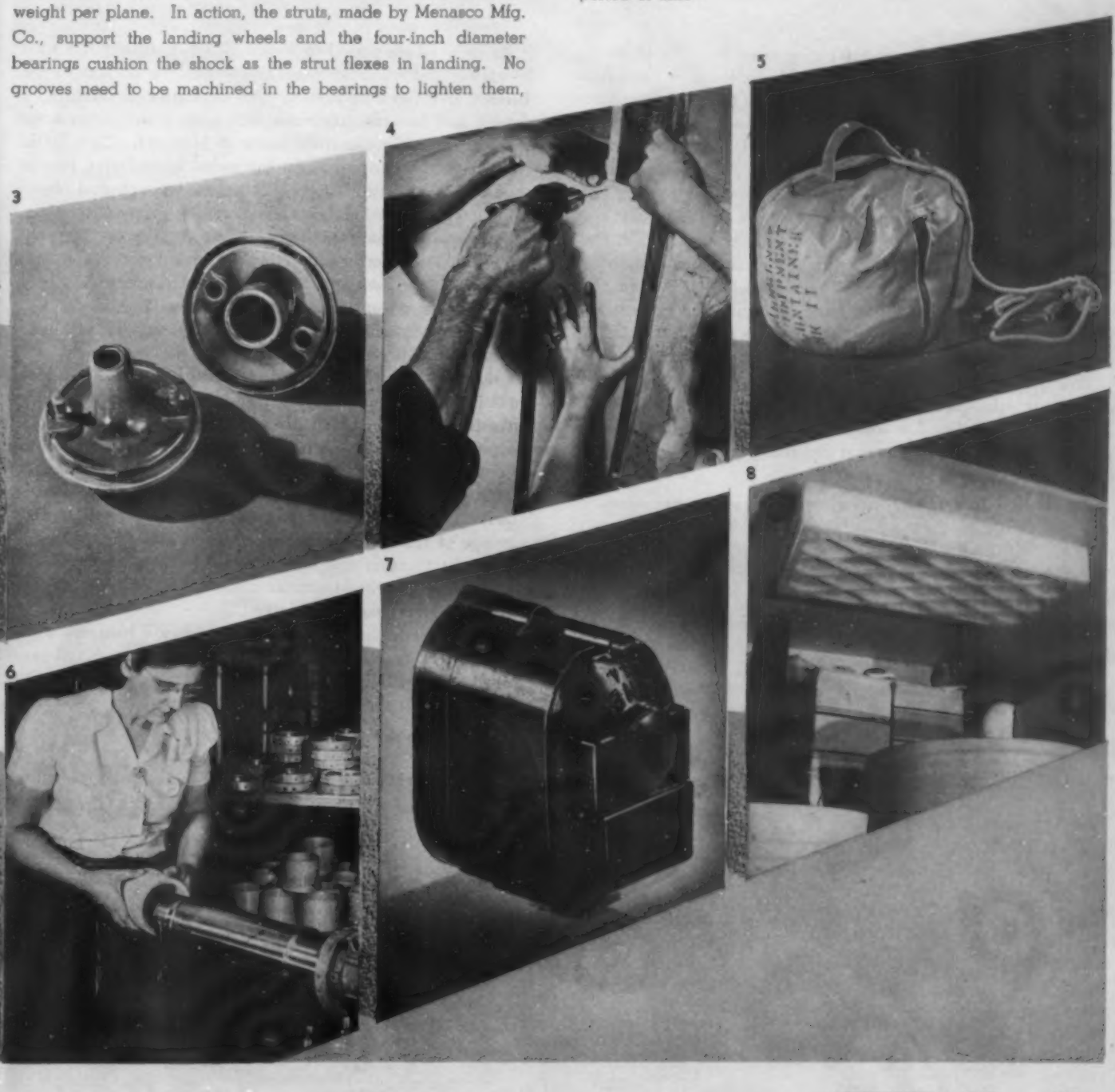
factured by Continental Can Co., Plastic Div., from Owens-Corning Fiberglas Corp. cloth, the lining has greater impact strength and is lighter in weight than the aluminum which was formerly used to protect these parts from damage. Its ease of application is an additional favorable factor

5 Lashed to a life raft or carried in a plane, this emergency equipment container carefully guards all of the basic survival devices against the ravages of water, sun, mildew and wear until the moment when they are needed. Made by Goodyear Rubber Sundries, Inc., of a strong cloth thoroughly coated with Vinylite, the compact zipper bag serves equally well in the depths of the jungle or at sea

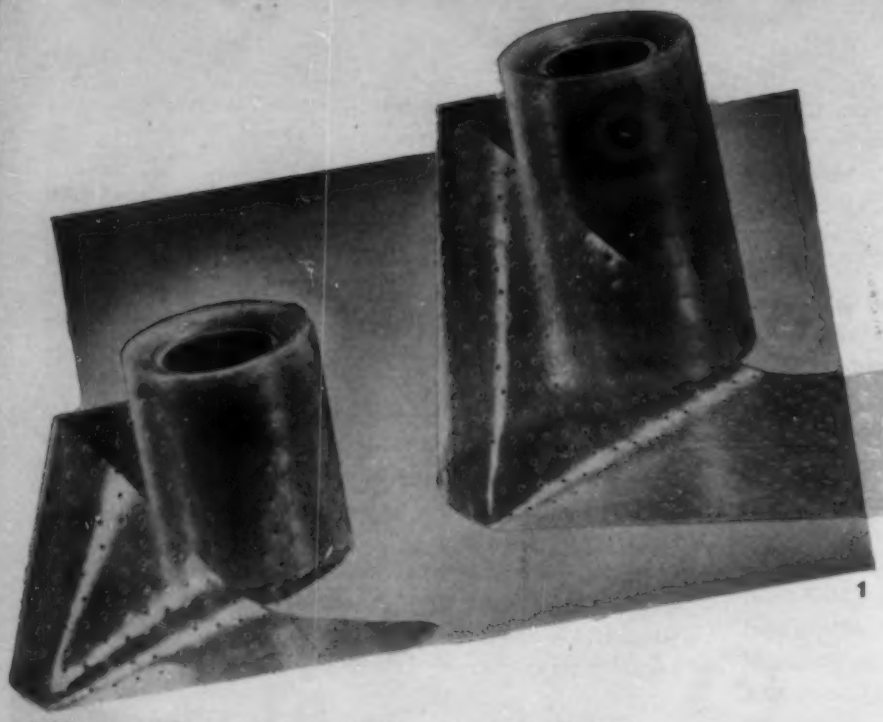
6 Fighter pilots can now carry 31 more rounds of 50-caliber shells in action against the enemy, since landing strut bearings on Republic P-47 Thunderbolt planes have been changed from bronze to Micarta—effecting a saving of eight pounds of weight per plane. In action, the struts, made by Menasco Mfg. Co., support the landing wheels and the four-inch diameter bearings cushion the shock as the strut flexes in landing. No grooves need to be machined in the bearings to lighten them, and only infrequent inspection is required in order to maintain the parts in top condition.

7 The motor gears which raise and lower the antenna mast and adjust the all-important landing lights of a plane are housed in a 3-piece Bakelite case produced by Plastic Research Products Laboratories for Grimes Mfg. Co. To assure the sustained alignment necessary, each of the integral parts is carefully molded to retain required stability. Two of the 3 sections contain molded-in inserts

8 Since many different types of food must share the same compartment in the frigidaire, special precautions must be taken to keep the odors of strong foods away from perishables, especially in these days of scarcity and rationing. This Ads-Orbo-Dor, mounted on a Lumarith frame molded by Plastic and Rubber Products Co. for Dulcinaire Mfg. Co. absorbs the unwanted odors and keeps the food fresher and sweeter for a longer period of time



FIRST AID



1

THE concept of plastic bandaging arose from the problem of finding a material that would eliminate or minimize the irritations, abrasions and dermatitis of the skin caused by adhesive plaster made from natural resins. The first possibility considered was that of cushioning the adhesive plaster by treating the skin with various lotions and creams to prevent direct adhesion of the plaster and thus minimizing the irritations. Numerous preparations were consequently applied to the skin which left a thin wax film upon which the adhesive plaster rested, but the protection they afforded proved inadequate. A search was therefore begun in the fields of natural and synthetic resins to find a more satisfactory medium which could be used in place of adhesive plaster and which would have the following characteristics: adhesive qualities, elasticity, ease of application, ease of removal without subsequent debris, freedom from toxic and allergic effects, availability, low cost and freedom from staining. The final acceptable form was that consisting of a vinyl resin with suitable plasticizers and solvents.[1]

[1] The materials discussed in this article are fully protected by patent.

2

As early as the period of World War I, natural gums such as mastic and sandarac were widely used by doctors in the British and German armies. At that time a mixture of mastic and benzene combined with some rosin or sandarac was known under the trade name of Mastizol. This liquid combination of natural gums succeeded in replacing plaster tape to a considerable degree, but there were several objections to its use. Since benzene or acetone were the solvents, they evaporated too rapidly from the container, leaving only a jellied mass. Too, after removal of dressings from the skin, a gummed debris remained that necessitated removal by benzene or other solvents that further irritated the skin.

No matter which natural gum was used, it was certain to contain some percentage of impurities which were difficult to remove. On the other hand, synthetic resins afforded custom tailored qualities that could definitely be controlled. Investigations were made therefore in 1942 at a New York hospital[2] into the possibilities of synthetic resins. Solutions of potentially suitable synthetic resins were compounded that would be safe to use on skin surrounding wounds. Plasticizers that would be satisfactory were also skin tested. Percentage of resin to solvent was checked and percentage of plasticizer to resin was also checked. After many months of skin testing various formulae, the satisfactory combination mentioned previously was evolved.

A series of tests were conducted and case histories compiled on the reaction of patients, many of whom had sustained adhesive burns from 4 months to a year previous to the application of the liquid. Fifty-three patients—37 male,

[2] Montefiore and Bedford Hills, N. Y.

1—The film shown here is perforated for use as a pressure bandage in skin burns. Being self-adherent, it requires no additional adhesives. 2—In skin grafting, the film is attached with rubber cement to a semi-cylindrical dermatone. The swivel-type blade of the machine cuts skin to any required depth, and the cut skin adheres to the film which prevents curling of its edges

FOR SURGERY

16 female—were subjected to the test for two different periods of time, spaced about three months apart. The portions of the anatomy tested were the volar side of the forearm and the lateral side of the chest. The liquid was applied to the edges of a gauze pad, 2 in. square, with a wooden applicator and the whole attached to the skin. Momentary finger pressure secured quick and adequate adhesion. When the bandage was removed, no sign of discoloration or skin burn was evident. The process was repeated daily until every patient had between 28 and 30 dressings applied during the course of the treatment. To assure the authenticity of this absence of reaction patients were kept under observation for delayed reaction, skin discoloration, itching or any other untoward condition. Of the total results from the two tests, only three reactions of mild erythema were observed, after the seventh, eighth and ninth day, respectively. These reactions all cleared within 48 hours.

Following these tests, samples and case histories were submitted to the Federal Food and Drug Administration for investigation. This group tested the formula and found it satisfactory for marketing.

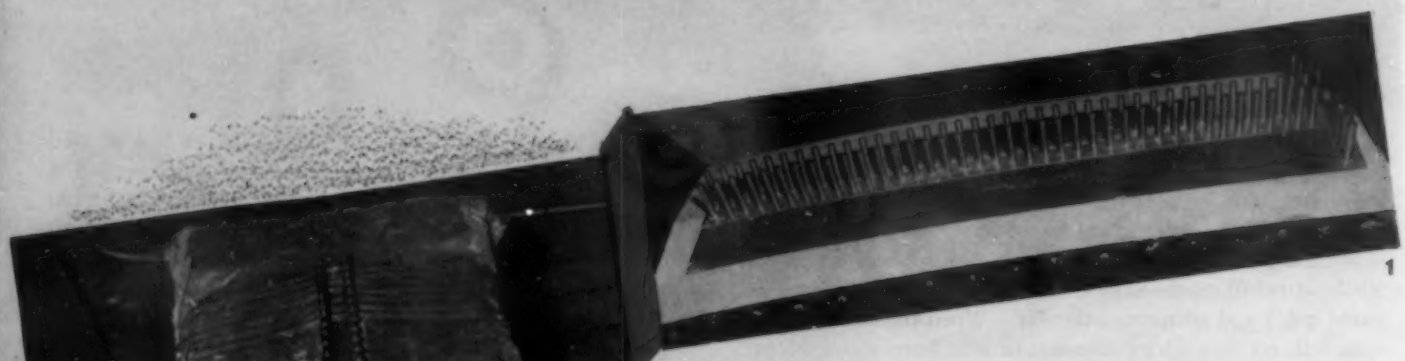
The liquid is made in two viscosities: thin and thick. The thin has been successfully used in several military hospitals as a protective skin coating before the application of adhesive plaster. It forms a complete membrane that is exceptionally soft, very flexible and resistant to most organic solvents. The film in no way interferes with the adhesion of adhesive plaster and definitely helps prevent the irritations and abrasion found when the latter is used alone. It can also be used on skin adjacent to draining wounds to prevent excoriation of the surrounding skin. For this purpose aluminum dust has been successfully incorporated in the liquid. Again, it affords a convenient antiseptic covering after injections and transfusions. Its use as a first aid dressing for cuts and injuries has been successfully demonstrated in industrial plants.

For cosmetic effect it has been used after suture removal. Droplets of the liquid are applied to the suture area, thus eliminating the necessity of an additional dressing and at the same time helping to draw the skin out. Dermatologists have found that the addition of specific medication to this liquid in the treatment of fungus infections such as athlete's foot were very successful. It tends to inhibit perspiration and has the added advantage of being antiseptic besides preventing moisture from entering the infected area.

The heavy liquid has unusually high tensile strength, yet is soft and highly flexible, conforming to the contours of the body without discomfort such as is the case when flexible collodion is used. Its principal use is in skin traction after amputation, fractures, and so forth. The liquid is coated around the skin above the wound, the stockinette or strips of bandage are set in place and pressure applied to make the stockinette adhere to the skin. No cleaning problem is presented after the removal of the stockinette, as all resin adheres to the dressing not to the skin. In areas difficult to dress, such as scalp wounds, eyes, ears, nose, axilla, etc., the use of this liquid eliminates the use of adhesive plaster. (*Please turn to page 178*)

3—The liquid adhesive is applied to the edges of a gauze dressing by means of a wooden applicator or spatula and the whole attached to the skin. Momentary finger pressure secures quick and adequate adhesion. 4—When the bandage is finally removed, no sign of any discoloration or skin burn is evident

PLASTICS PRODUCTS*



1

2

3

THE PRODUCTION OF ECONOMICAL AND SATISfactory jigs and tooling is of vital importance to the aircraft industry, particularly since so many of its tooling problems involve the production of only a small number of parts. Most companies in the industry have found many places where plastics have materially aided their tooling operations.

A case in point is a jig which permits accurate location and drilling of eighty-six 0.500 to 0.750-in. holes at the wing junction of an airplane model. The aluminum surface to be drilled had a double curvature, and it was essential that all holes be normal to the surface. Since construction of any metal jig would have been difficult, it was decided to use a glass-fabric structure bonded with phenolic resin to hold steel bushings.

Figure 1 shows the details of the form on which the jig was constructed. A template of 0.064-in. steel was bent to the desired skin contour, holes located, and steel locating pins attached by countersunk screws for the under side. The locating pins were then coated with vaseline, and a one-inch layer of plaster poured around them, smoothed carefully, and allowed to set. The plaster surface was given 5 coats of cellulose nitrate lacquer to seal it and to provide a separating medium between the plaster and the finished jig.

Hexagonal bushings with undercuts to provide anchorage were placed on locating pins. Nineteen layers of glass-fiber cloth, heated in an air oven for 30 min. at 400° F. to decompose the lubricant and give better bonding to the resin, were built up one by one—each layer being impregnated with catalyzed phenol-formaldehyde resin and the bubbles marked out by hand. To insure bonding around the bushings, strips of glass fiber were laid along and between each bushing (Fig. 2).

An unimpregnated $^3/_4$-in. rope was laid on each side between the 10th and 11th layers to form a stiffening bead for added rigidity. The complete assembly was then placed in an air oven and cured for 96 hr. at 180° F. to set and dry the resin completely. When the assembly had cooled, it was removed from the mock-up frame and finished. The jig was then separated from the coated plaster, and mounted in place on the master wing assembly jig (Fig. 3).

Credits—Materials: Fiberglas; Baker Oil Tool Co. phenol-formaldehyde resin. Jig formed by Consolidated Vultee Aircraft Corp.

PLASTIC MATERIALS ARE USED TO A LARGE EXtent in the latest gas mask to be developed by the Technical Division of the Chemical Warfare Service—the head-wound gas mask, M7-11-9. This mask (Figs. 4 and 5), designed at the request of the Medical Department, is the first device to

* Reg. U. S. Patent Office.

afford protection to patients with bandaged heads, faces or jaws against the effects of war gas. The head-wound mask consists of a flexible transparent vinyl resin hood to which an air purifying canister and an outlet valve are attached. Air is drawn into the mask by normal breathing. A window of semi-flexible vinyl sheeting allows clear vision.

Unlike standard military masks, the head-wound mask is adapted for use over any type of head, face or jaw dressing. After the mask is pulled over the head like a sack, the skirt of the hood can either be fastened tightly around the neck, or a gastight seal provided by taping the hem to the wearer's chest. Four long straps attached to the hood are crossed under the chin and tied on top of the head. In addition, a short strap goes around the neck and is knotted in back.

The replaceable canister is a stubby cylinder similar to the type used on assault gas masks. The small outlet valve is of cellulose acetate and the oblong waterproof carrier consists of a vinyl resin sack.

The design of the mask is the result of long experimentation at the Chemical Warfare Service Development Laboratories at the Massachusetts Institute of Technology. The problem was to develop a mask which was not too bulky, could be readily compressed for shipment, was easy for the hospital attendant to put on the patient, comfortable to wear, and constructed of materials available in quantity. Its canister had to afford adequate protection against toxic gas vapors.

Credits—Material: Mask and carrier sack, Vinylite. Masks by National Carbon Co. and Firestone Rubber and Latex Co. Tape by Industrial Tape Co.

THE MAJOR OBJECTION TO THE USE OF REFLECtive optics in television receivers has been the high cost of the aspherical correcting lens (Figs. 6 and 7). This lens, similar to a figure of revolution developed by rotating a shallow letter S around one of its ends, is not a naturally generated surface, and there are no machines on the market for straightforward production of such surfaces. In the early stages of its development, methods and machines were used based upon astronomical technique, which were exceedingly high in cost. The apparent solution to the cost problem was that of molding these lenses from clear methyl methacrylate.

The molding process is essentially that of applying very high pressure to the heated methyl methacrylate, which is confined in a heated mold and cooled under pressure until it reaches room temperature. The only operation which remains is that of boring a hole in the center of the lens (A, Fig. 7) for accommodating the neck of the cathode-ray tube.

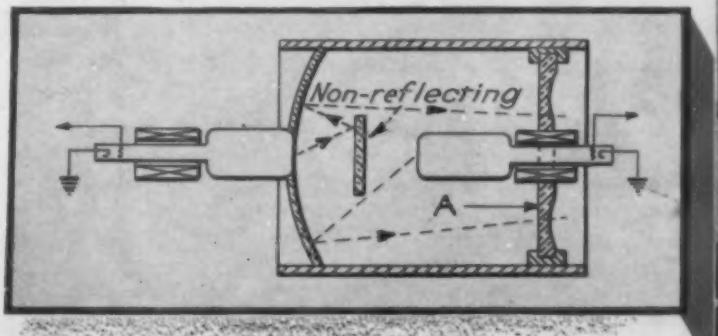
Credits—Materials: Plexiglas and Lucite. Lens by RCA Victor Div., Radio Corp. of America. Data presented from a paper by I.G. Maloff and D.W. Epstein, Nat. Electronics Conf., Chicago, 1944

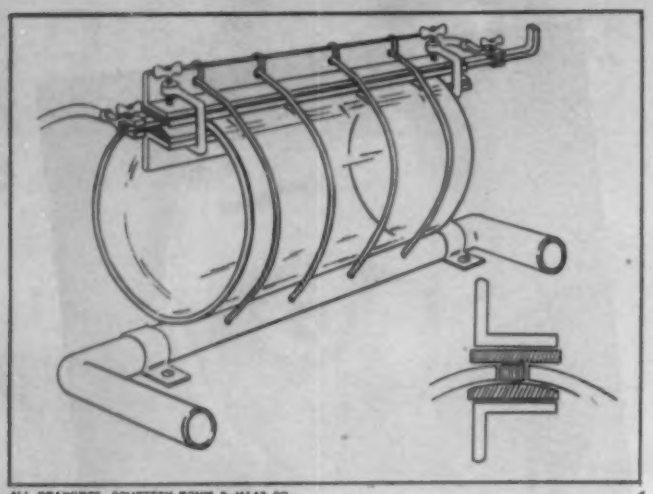
4

5

6

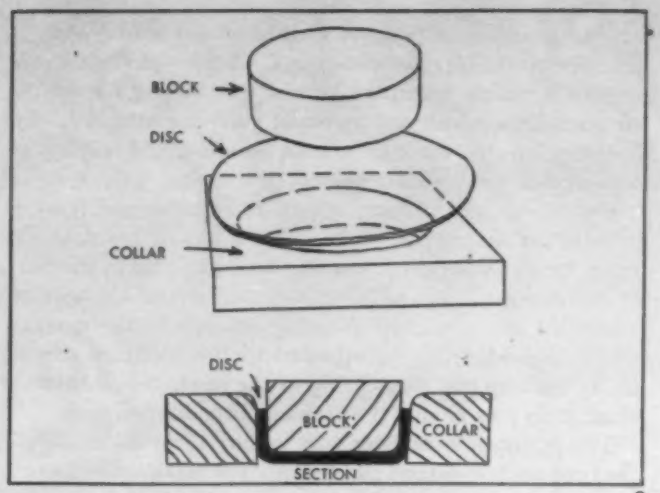
7





ALL DRAWINGS, COURTESY ROHM & HAAS CO.

1



2

1—With a heating strip inserted in the joint made by the two edges of the frustrum, pressure is obtained by passing ropes through holes in the pipe to which the transparent part is attached, passing them around the frustrum and through holes in the flange of the confining strip. 2—The cap to be welded to the frustrum is shaped by pressing a flat sheet into a hole of the desired character and forcing it down with a plug of the desired interior diameter

New forming technique

by H. F. PEARSON*

WHEN an acrylic resin section of three dimensions is fabricated by the normal vacuum or vacuum and snap-back process, there is an inevitable loss of thickness due to the stretching of the material. Thus, forms such as a bottle or hemisphere on a cylinder cannot be made by these methods without an important thickness variation, but they can be obtained satisfactorily through the use of a newly developed forming technique.

This process is made up of five separate steps. Using flat or curved material, a form is made approximating as closely as practicable the shape desired in the finished article. The joints are then butt welded by means of a special heat-welding apparatus, and the exterior of these joints carefully polished. Finally the form is heated and air pressure applied to blow the material into a mold of the desired shape. Not having been stretched excessively, the acrylic resin in the finished object is of a much more constant thickness than is the case when other forming methods are employed. In addition, the reheating of the welded joints dissipates any stresses that may have developed as a result of rapid cooling following the welding operation. Consequently, if properly made, these articles have a strength approximating that of the acrylic resin itself.

The process was developed when an attempt was made to manufacture a housing consisting of a cylinder closed at one end by a hemisphere. Two acrylic resin pieces were necessary for the production of this part—a section that later became the cylinder and a part which was formed into the hemisphere. Because of the excessive stretch involved in forming a hemisphere from a flat sheet of acrylic resin, the cylinder was first designed as a frustrum of a cone—the larger circumference being that of the desired cylinder, the smaller that of the hemisphere at half its height. With this design, in the assembly of the two sections the cap had to be stretched only a short distance to form a spherical section of the size desired for the periphery of the hemisphere while the frustrum had to be stretched an equally short distance to meet the measurements established for the circumference of the cylinder and, therefore, of a size to match the lower edges of the hemisphere.

The sheet from which the frustrum was to be formed, was cut slightly larger than necessary in order to compensate for the edge trimming that was necessary when the ends of the sheet were fitted together preparatory to welding. To avoid too great distortion in the welded joint, the frustrum was confined laterally by two strips of transite attached to two 2 by 2-in. angle irons (Fig. 1). These strips were clamped above and below the joint of the acrylic sheet and a heating element of the same thickness as the plastic inserted between the edges to be joined.

To obtain pressure, a piece of 2-in. pipe—slightly longer than the transparent tube and with its ends turned at right angles to form two levers—was bored at 6-in. intervals. Placed between two 2 by 4-in. members, this pipe was next attached to a solid base. Ropes were passed through the holes in the pipe, around the frustrum, through holes in the projecting flange of the confining strip, and securely tied. The raising of the levers caused the pipe to turn on its axis, twisting the ropes about themselves. This action had the effect of tightening the ropes around the frustrum and closing the joint with very considerable pressure. This pressure device might almost be described as a tourniquet jig.

With the joint closed, the ends of the heating strip were connected to a transformer and the current turned on. The electricity continued to flow until the material was at the smoking temperature. Then, for the space of about 10 sec., the hot metal was allowed to cool until the edges of the plastic in contact with the heating strip were in a liquid condition. With the connecting wires removed, the pressure relieved and the blade pulled from (*Please turn to page 178*)

*Rohm & Haas Co.

PLASTICS*
Engineering Section
F. B. STANLEY, Editor

The procedure of die hobbing

Hobbing, a specialized phase of mold making, was conceived in about 1876. Basically it consists of sinking a properly hardened, highly polished steel master of an article into a piece of soft steel through the use of a hydraulic press

by ISLYN THOMAS† and JOHN HOHL**

DUE to the inevitable competition of plastics with other materials in the postwar era, quality and economy of production will be of great importance to every manufacturer of plastics products. Each factor which influences the character of the molded part, its surface appearance and cost of production will take on added significance. Since hobbing of cavities is almost the only certain method for insuring uniformity and economy in production on multiple cavity molds, this phase of mold making should be of intense interest to designers, production men and sales engineers.

The purpose of this article is to broaden the toolmaker's viewpoint on hobbing and to familiarize the plastics sales engineer and his customer with this highly specialized phase of mold making so that they will understand and more fully appreciate the advantages of hobbed cavities and the problems facing those who supply them with dies.

Hobbing practice as we know it today is a specialized phase of mold making closely associated with the plastics industry. In certain sections of our country this method is called "hubbing" and hobs are called "hubs." According to the Metals Handbook of American Society of Metals the distinction between hobbing and hubbing is as follows: hubbing—a method of displacing metal; hobbing—a method of removing metal. Thus it would appear that both terms are correct. However, for the sake of clarity this phase of mold making will be referred to as hobbing throughout the balance of this article.

Origin of hobbing

The so-called method of hobbing was conceived in about 1876 by Charles Burroughs, Sr., founder of Burroughs Engineering Company. After the discovery of Celluloid by Hyatt in 1869, it was found that in order to produce toothbrush handles, harness buckles and similar molded items in fairly large quantities, it would be necessary to have multiple cavity molds. Early experiments proved that steel cavities were best suited for the work. However, production of these

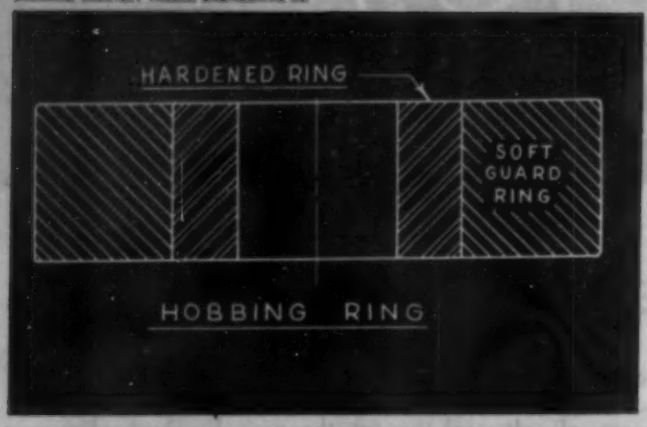
† Consultant, Thomas Engineering Co., E.S.M.W.T. instructor, Brooklyn Polytechnic Institute.
** President, Newark Die Co., Inc.

1—Using a hydraulic press, a highly polished steel master hob can, if properly hardened, be sunk into a piece of soft steel. 2—Hobbing is the more satisfactory method of producing cavities having raised letters or numerals

2

PHOTO, COURTESY NEWARK DIE CO., INC.

* Registered U. S. Patent Office.



3

4

5

6

steel cavities by machining was very expensive due to the necessity of filing and stoning out tool marks. Also, it was practically impossible to produce cavities of uniform size and contour by this method.

In experiments to produce economically cavities having a high polish, and uniformity of size and contour, Mr. Burroughs found that a highly polished steel master of the article (called a hob), if properly hardened, could be sunk into a piece of cold soft steel through the use of a hydraulic press as shown in Fig. 1. When the hob was removed from the soft steel cavity, the surface of the cavity was as highly polished as the hob. Furthermore it was discovered that in compressing the soft steel the pores of the steel were considerably diminished in size—making a closer-grain piece. From the master hob, many mold cavities could be produced, unvarying in size and with duplicate polished surfaces.

Hobbing as we know it today has undergone no basic change. However, many improvements had to be made in equipment, hobbing steels and technique to meet the tremendously increased demand for mold cavities of larger size, with closer limits, and in shapes unheard of in the early days of the plastics industry.

Procedure

There are many times when cavities are machined when they should be hobbed, and hobbed when they should be machined. Misunderstanding, lack of the necessary specialized equipment and ignorance of the technique that can only be developed by many years of experience are responsible for a certain amount of this misapplication. There are pieces which are difficult to hob because of bosses, shoulders and weak sections—conditions which may make hobbing an uncertain operation. The ill-advised choice of the hobbing method has been the cause of more delays and added expense than any other factor in the construction of molds.

There are a number of variables that should be considered before determining whether a certain cavity should be machined or hobbed. The number of cavities to be made, the availability of the necessary equipment, the uniformity between cavities, the quality required in the finished article and the kind of steel to be used—all must be taken into account before an equitable decision can be reached.

In some cases, the best procedure is a combination of machining and hobbing. At other times hobbing is the only satisfactory method of producing cavities. This is true of dies having raised designs, numerals or letters for the molding of dials (Figs. 2 and 4).

Hobbing press

Due to the tremendous growth in demand for hobbed cavities of all shapes and sizes, hobbing presses have increased in size and capacity from approximately 50 tons to 3000 tons

3—Hobbing rings are designed to support the soft hobbing blanks and prevent them from spreading away from the hob while under pressure. Their size is governed by that of the blank which must fit inside the center hole of the hobbing ring. 4—Use of the hobbing process facilitates the duplication of molds—in this case cavities with intricate designs that later will appear on ladies buttons. 5—One of the latest rodless-type hobbing presses to be developed has a capacity of 2000 tons. 6—Hobbing rings come in a wide range of sizes, some as big as this round ring that is just being put in the press

and over. One of the latest models (Fig. 5) has a capacity of over 2000 tons.

This rodless type of press was invented by Charles F. Burroughs, a son of Charles Burroughs, Sr. It is a one-piece steel casting with cylinder, tension members and top head combined in an integral unit. Anvils, or wearing plates, are mounted on the top of the ram and on the top of the press. Accurate machining assures that these members are parallel when assembled. Since there are no nuts to loosen in operation this relationship is maintained throughout the entire life of the press.

The press is controlled by two hand wheels which operate valves that regulate the flow of liquid from the pump and consequently, the action of the press. When hobbing a die, the hardened hob is placed in position on top of the soft steel blank. The ram is lowered under low pressure until it comes in contact with the back of the hob. At this point, due to the resistance set up by the hob pressing into the blank, the low-pressure pump is by-passed and the high-pressure side comes into action.

Hobbing rings

Hobbing rings, or chases as they are sometimes called, serve to support the soft hobbing blank and keep it from spreading diametrically away from the hob while under pressure. Generally the hobbing rings, which are made of hardened chrome nickel steel, are supported on the outside with a soft steel guard ring as shown in Figs. 3 and 9. These hobbing rings are not necessarily round; they may be rectangular in shape.

In the case of certain molded items of rectangular or oblong shapes these square-cornered chases make possible the use of much smaller hobbing blanks than would be practicable if only round hobbing rings were available. The sizes of the various round hobbing rings (Fig. 8) are determined by the inside diameters of the chases which vary from $^5/_8$ to $13^1/_2$ in. and more. Since the hobbing blank must fit inside the ring as shown in Fig. 9, the size of the ring used for a specific job depends upon the size of the hobbing blank which is selected.

Both the round and the squared hobbing rings are divided into two more groups according to whether the center hole is straight or tapered. The tapered ring which is not in general use, being limited to special jobs, is used to help control the flow of metal toward the hob (Fig. 10).

The hob

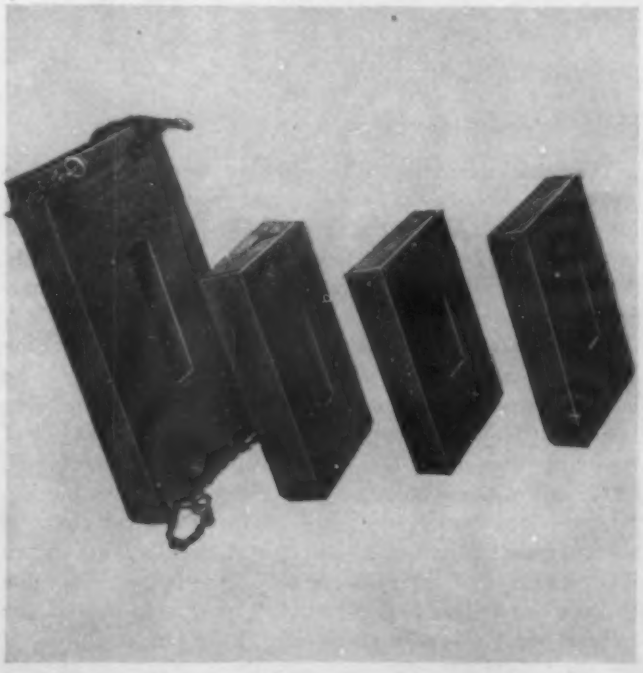
A very important part of the tool equipment necessary for hobbing cavities is the hob—the master form with which the correct shape is impressed in the cavity. The hardened steel hob, as can be seen in Fig. 12, is a replica of the article to be molded. Sometimes, due to unavoidable hobbing difficulties, certain features of the article to be molded are left off the master hob. In these cases, the cavity is machined after being hobbed. An instance of this type is shown in Fig. 13, where the upper part of the cap has been left off the hob to avoid possible breakage due to the length of this section.

While the design of hobs varies from one shop to another, there are some fundamental facts which should be adhered to. These include the incorporation of as many fillets as possible, elimination of sharp corners, the use of the maximum permissible taper or draft which should be a minimum of 0.010 per in. per side, highly polished surfaces and no undercuts. The miscellaneous hobs shown in Figs. 11 and 14 give an idea of the large variety of shapes that can be produced by the hobbing method.

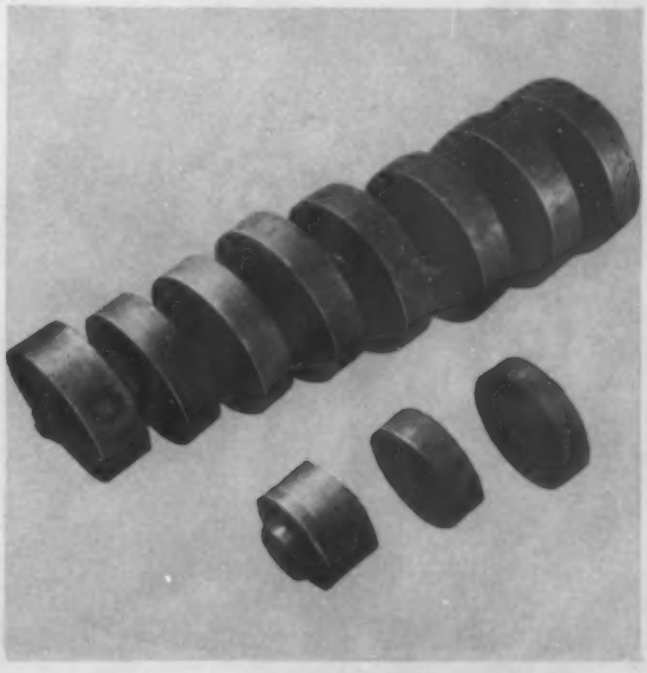
In the selection of steel for the hob certain primary essentials stand out such as machining characteristics, minimum shrinkage on hardening, depth of hardness, compression strength, and the combination of substantial hardness with toughness. An oil-hardening chrome-tungsten-vanadium steel is well suited for the making of a hob and, if properly hardened and well polished, it will stand up under heavy hobbing pressure. A typical analysis of this steel would be as follows: carbon, 0.45; chromium, 1.25; tungsten, 2.75; vanadium, 0.25. (*Please turn to next page*)

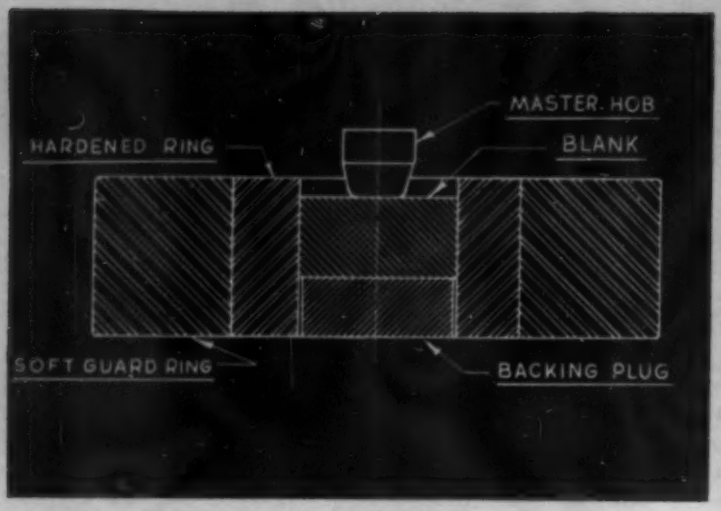
7 *and* **8**—*The differentiation between hobbing rings extends beyond a division into round- and square-type groups. Variations are also to be found in the center holes which may have straight or tapering walls depending on the application. The hobbing ring at the extreme left of Figure 7 measures over five feet in height and weighs more than a ton*

7 ALL PHOTOS, COURTESY NEWARK DIE CO., INC.

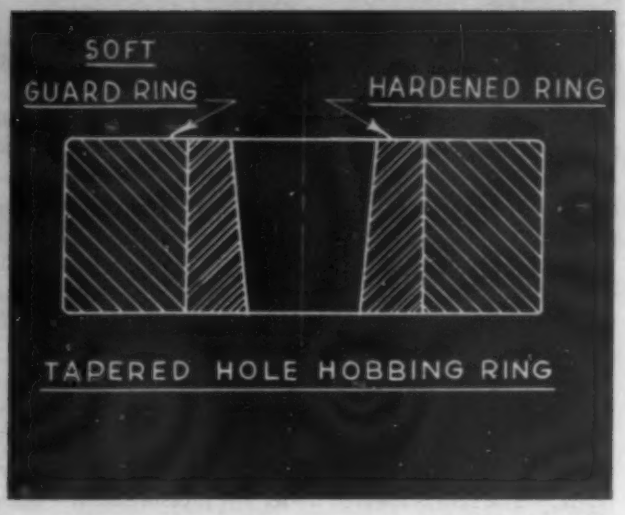


8





9



10

9—Only the press is missing from this drawing of the parts required for hobbing and their relationship to one another. 10—Tapered center holes are used in hobbing rings to help control the flow of metal toward the hob

There is no single steel best suited for hobs, although most mold makers agree that oil-hardening non-deforming tool steels are preferable. However, everything from high-carbon high-chrome air-hardening steels to the tough steels mentioned above have been used successfully.

Hobbing blanks

Successful hobbing depends to a great extent upon the blanks for the impressions or hobbings. These blanks, of all shapes and sizes (Fig. 22), are made from special hobbing steels and are generally annealed before using due to possible variation in the density of the steel. The selection of the proper steels is of extreme importance and the following factors should be borne in mind: hobability, cleanliness, uniformity, machinability, hardenability, wear resistance, strength and finish.

There are several types of steel which have been developed for hobbed cavities. One is a low-carbon case-hardening steel with a maximum Brinell hardness of 100 which is used where ease of flow under pressure is required. A typical analysis would be as follows: carbon, 0.05 to 0.10; manganese, 0.15 to 0.25; phosphorous, 0.03 to 0.05; sulphur, 0.02 to 0.03. This type of steel does not produce a high core hardness but will give a good wear resisting surface hardness if properly carburized.

When greater toughness and resistance to upsetting is required, chrome-nickel steels are used although greater difficulty is encountered in the hobbing operations. A typical analysis would be: carbon, 0.10 to 0.20; manganese, 0.30 to 0.60; nickel, 1.00 to 1.50; chromium, 0.45 to 0.75. These alloy steels are generally supplied in Brinell hardness ranging from 120 to about 160. In certain instances it is also possible to hob well-annealed tool steel blanks within certain limits despite the fact that this material does not lend itself readily to deep hobbing because of its poor flowing quality.

The first step in the preparation of a blank is the grinding and polishing to a mirror-like finish of the surface which comes in contact with the hob. Then, after being fitted to the hobbing ring, the blank is ready for the first push. To help reduce the power needed to hob the impression, some blanks are relieved by removing metal from the bottom as shown in Fig. 15. The amount of steel removed varies from approximately 10 to 60 percent depending on the type of hobbing steel, the shape of the hob and the pressure to be used for the particular application.

ALL PHOTOS, COURTESY NEWARK DIE CO., INC.

11

Hobbing operations

The actual mechanics of the hobbing operation are simple and easy to describe since the only movement necessary is the forcing of the hob into the plain blank. However, years of experience are necessary before the sort of cavity commonly demanded by the industry today can be produced with guaranteed consistency.

After the hobbing ring is set in the press, the backing plug and the already polished soft blank are placed inside it. The hob is then put in position over the blank (Fig. 16), care being taken that all foreign matter is removed since even a piece of lint lying between the hob and the impression will be found, at the end of the hobbing operation, to have left its imprint. No oil or lubricant should be used between hob and cavity if an extremely high luster is desired. On those occasions when a lubricant is thought necessary to prevent hob breakage due to excessive friction, blue vitriol (copper sulphate) is the solution most generally employed. However, a solution of

12

13

12—*The steel hob is a replica of the article to be molded, in this case a rattle in the shape of a French phone.* **13**—*The upper part of this hob has been left off to avoid breakage due to the length of the small diameter section*

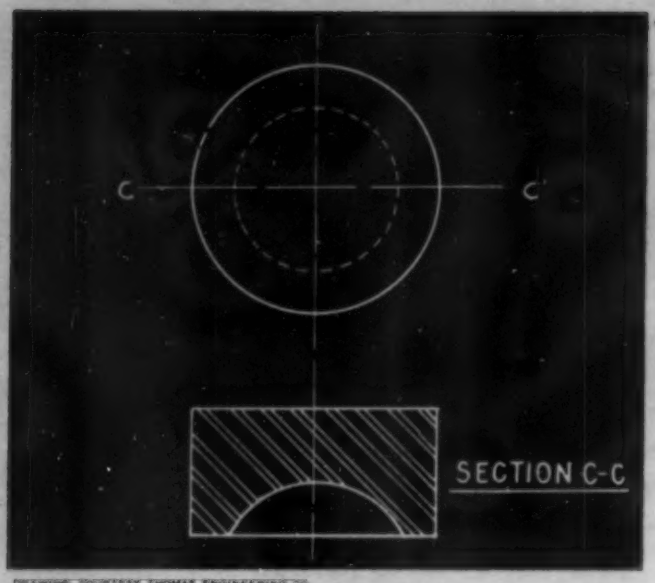
15 gr. of copper sulphate and 5 gr. of oxalic acid in 50 cu. m. of water is an alternate solution and one which has proved very satisfactory.

The next operation is the opening of the valve on the press which regulates the flow of liquid from the pump to the base of the ram. As soon as the ram encounters the high resistance set up when the hob starts to press onto the blank, the low-pressure pump is by-passed and the high-pressure side comes into action. The ram then starts its ascent. Although this movement of the ram is very slow, a hobbing or impression may be finished within 45 to 90 sec.—the time, of course, depending upon the depth of the impression. As the hob sinks into the blank, the operator watches the pressure gage. Ordinarily, the pressure rises to the maximum required for a particular hobbing and then remains nearly stationary while the hob continues to sink very slowly into the impression. This continuation of the hobbing operation at practically the same pressure indicates that the work is proceeding satisfactorily and that the metal is flowing around the hob. When the pressure rises rapidly it indicates that the hob has stopped sinking. Pressure should be released as soon as this condition is noted by the operator if irreparable damage to the hob is to be avoided.

The cavity may be hobbed in one operation. However, if the blank offers too great a resistance to the entrance of the hob due to the depth of the proposed cavity, the hob should be removed, the blank annealed and possibly relieved. It may be necessary to repeat the action several times until the hob has gone deep enough into the blank. Insufficient press tonnage will also make the removal and annealing of the blank necessary before the hob can be sunk to its final depth. When several squeezes are required to reach the desired cavity depth, the partly hobbed cavity must be annealed to relieve the strain before any additional squeezing or machining may be done on the blank. The more thorough the annealing, the softer the blank, and the lower the pressure required to sink the hob. A few points variation in the amount of carbon in the steel may increase by 100 percent the pressure required

14

11—*Hobbing is particularly suited to the forming of multi-cavity molds. The variety of designs possible with this method are evident in these small button hobs.* **14**—*Even when only a few large cavities are to be formed, hobbing frequently is the cheaper and easier method*



15

DRAWING, COURTESY THOMAS ENGINEERING CO.

15—Blanks are frequently relieved by removing metal from the bottom. 16—The surface of the blank must be polished to a mirror-like finish. 17—Such high pressures are necessary when hobbing tool steel that a special 3-piece split-type inner ring is used. Here the split ring and hobbed blank have been pushed out of the ring. 18—The split ring can be opened easily

16

17

ALL PHOTOS, COURTESY NEWARK DIE CO., INC.

18

to hob the cavity, and results will be unsatisfactory due to the poor flowing quality of the steel.

The number of annealings required by a blank varies from one to as many as six, depending on the depth, etc., of the finished cavity and the fragility of the hob. The annealing process involves placing the plugs or cavities in steel containers packed with charcoal, sealing the cover with fire clay to exclude air, raising the temperature of the entire unit to 1500° F., then allowing it to cool off slowly in the furnace.

The pressures required for hobbing ordinarily range from 50 to 200 tons per sq. in. of die impression. Not only does the pressure vary according to the different compositions of the steel, but also with the method of hobbing. For instance, if the die blank is confined by a chase ring, the pressure may be double that which would be required if the blank were unconfined. In some plants where only small dies or molds are used, a press with a 150-ton capacity meets the requirements. In other plants a press capable of exerting a pressure of 1000 or possibly 5000 tons may be necessary.

After a die has been hobbed in the manner described, the impression has a fine finish and clean-cut edges which can be attributed to the fact that the enormous pressure exerted on the blank increases the smoothness of the metal. The speed with which the hob can be sunk into the blank varies according to the size and depth of the hob. That is, a large cavity cannot be hobbed as fast as a small one due to the flow properties of the steel and to the fact that the use of a high-speed pumping unit on a large press is neither sound nor economical. Within certain limits, therefore, the maximum ram speed is fixed. More exact speed adjustment is based on the operator's skill and experience—a circumstance which must be provided for in the design of the equipment. In hobbing tool steel, such a terrific pressure is required as to necessitate the use of a large hobbing ring and a special hardened three-piece split-type inner ring. Figure 17 shows the split ring and hobbed blank after they have been pushed out of the large hobbing ring with the use of parallels. In the next operation (Fig. 18) the split ring is opened up and the hobbed blank or impression removed.

After the last hobbing operation has been completed the upper surface of the hobbing, which is irregular owing to the unequal flow of metal, is machined to whatever shape may be required to make it match the opposite die section. The die is then pack-hardened to a depth of about $^1/_{16}$ inch. The temper may also be drawn, although the need for this treat-

ment depends upon the class of service for which the dies are intended. The final operation is that of polishing the surfaces of the impression to restore whatever luster may have been lost in the heat-treatment. If the operation has been carried out properly, the cavity and article (Fig. 20) will be a perfect replica of the hob; and the luster of the hob will be imparted to the die. This luster is more lasting than that secured by polishing because it is due to the metal of the die flowing and condensing under the hobbing pressure.

"Don'ts" of hobbing

Don't design or make a hob with a large, heavy base. In most cases it is much better to make the hob throughout its entire length the same size as is required for the impression (Fig. 19). Closing-in operations are sometimes necessary to make good hobbings, and large shoulders make such operations impossible.

Don't make the outside dimensions of the cavity any larger than necessary; a $^3/_8$ or $^1/_2$ in. wall thickness is ample for most cavities. Small impressions in large blanks make good hobbing difficult and, in some cases, impossible.

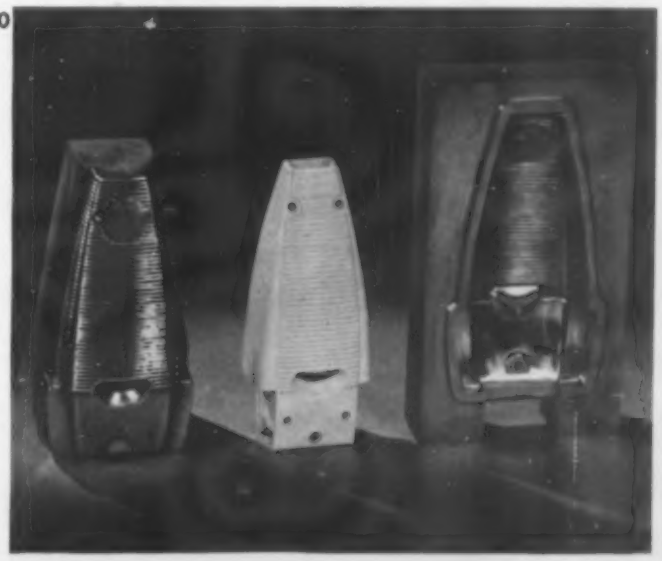
Don't select a water hardening tool steel for a hob; it generally does not harden deep enough.

Don't think that all there is to hobbing is placing the hob on the blank and applying a predetermined amount of pressure. The actual operation of the press does not require the services of a specialist since the only precaution that must be taken is that of guarding against overloading the hob. The real work and art is in the preparation of the blank before it is placed in the hobbing ring. On one push impressions the amount and location of relief is extremely important. But, it is on those impressions requiring two or more squeezes that the hobber's skill and experience really comes into play. If preparatory work on the blank is not done correctly, a good hobbing cannot be produced.

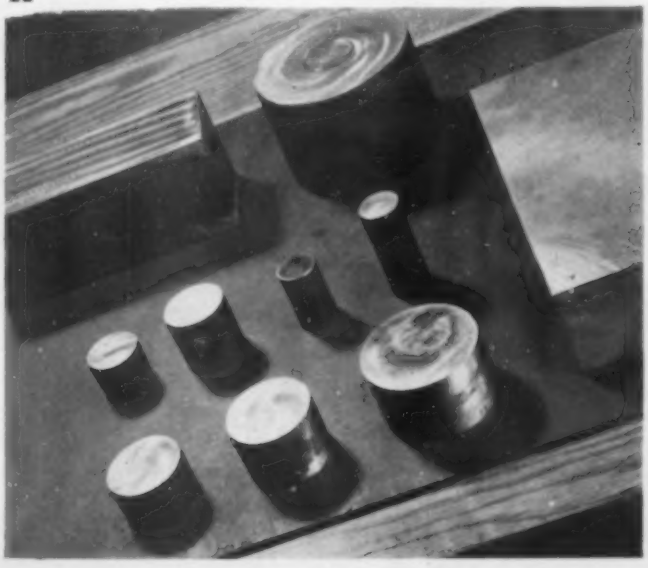
Hobbing is not like a machine tool operation where the work is constantly in view. When the blank is in the ring and the hob is sinking, you cannot see what is happening. The results can only be known when the hob is removed from the impression. Unless you have had experience, the result is a broken hob. It takes only a few seconds in a hydraulic press to ruin a hob on which many hours and many dollars have been spent. If you have work you think can be hobbed, consult a good hobber before making either hobs or blanks. He can save you trouble, time and money.

19

20



22



21

***19**—Instead of having a cumbersome base, this hob was made, throughout its entire length, the same size as required for the impression.* ***20**—The cavity and article are perfect replicas of the hob if the operation has been carried out correctly.* ***21**—A molded telephone base and its hobbed cavity.* ***22**—Hobbing blanks, coming in all shapes and sizes, are generally annealed before use*

Plaskon adapter cone molded by Recto Molded Products, Inc., Cincinnati, Ohio

PLASKON

TRADE MARK REGISTERED

MOLDED COLOR

Plaskon *is on*

Active Service Duty Everywhere

THE GREAT RANGE of features offered by Plaskon has stimulated its application to many difficult and unusual jobs.

Typical among these is the Plaskon Molded Color adapter cone used on the United States Army Field Unit for dental X-ray purposes in base hospitals. Here Plaskon supplies the *uniform density* that is an absolute requirement of the cone. Any variation in density, or the use of metal, glass or other substances of high atomic density, would cause objectionable images on the film. And Plaskon does not break down under the terrific impact of X-rays which can disturb the molecular structure of many materials.

Because the cone is used in close proximity to the face, Plaskon supplies the obvious needs for a smooth, high-lustre finish that will remain clean, bright and sanitary. High dielectric strength, resistance to shock, retention of dimensions over a wide temperature range, and moldability to high precision standards, are other advantages which determined the selection of Plaskon for this important use.

Plaskon can be supplied in a complete range of colors, and can be molded into shapes and sizes serving many practical needs at attractively low costs. Our experienced technical men will give you valuable assistance in adapting Plaskon materials to present needs and peacetime planning.

PLASKON DIVISION

LIBBEY • OWENS • FORD GLASS COMPANY • 2121 SYLVAN AVENUE, TOLEDO 6, OHIO

In Canada: Canadian Industries, Ltd., Montreal, P. Q.

Screw extrusion of vinyl resins

by W. F. HEMPERLY*

NEW types of extruders for use with thermoplastic materials, developed through the cooperation of plastics producers and tubing machine manufacturers, differ from the conventional rubber extruders in that the cylinder and screw are approximately one-third longer, provisions have been made for the insertion of breaker plates and screens, and the thrust sections are more ruggedly built so as to absorb the increased back pressure which is built up. This increased back pressure permits the development of greater frictional working, which results in greater plastic flow and uniformity. Provision can be made for heating the head and the die individually, and for closely controlling the temperature of the cylinder and screw during the course of the extrusion process.

A typical setup for resin insulation of wire and cable is shown in Fig. 1. The auxiliary equipment includes facilities for heating the wire before it passes through the extruder, an annealing oven for the extruded product, a cooling trough, and reels for the bare conductor and for the insulated wire. No less important is the machinery for turning the screw at optimum speed.

In the extrusion of rods, tubing (Fig. 3) or other shapes, it is usual for a straight head to deliver the material directly to the belt. The annealer, cooling trough, capstan, wire heater and similar equipment peculiar to wire insulation are not required for this work.

Barrel and screw

The design of the barrel and screw of the plastic extruder has gone through many stages, and development work continues. In considering these two parts, it should be remembered that the operation of any plastic screw extrusion machine depends upon the differential between the frictional forces exerted by the material on the screw and the forces acting against the cylinder wall to bring about proper plasticization of the stock. It is for this reason that all designs are directed toward decreasing the frictional force on the screw and increasing the force on the cylinder wall. A suitable state of plasticity must be maintained throughout the cylinder at all times.

Either single- or double-lead screws can be used for extruding vinyl resin compounds, the principal difference being the somewhat higher extrusion pressure which can be developed with the single-lead type. Contrary to experience with the extrusion of rubber, there is no danger of marking the extruded plastic product through the use of single-lead screws. Screws designed with a decrease in pitch from the magazine end to the die end develop greater pressure than constant pitch screws and are, therefore, preferred for this work.

Clearance between the screw and the wall of the cylinder is an extremely important factor because of the relationship between this clearance and the pressure developed. Preferably, the clearance should be 0.005 in. on each side of the screw, but in no instance should it be in excess of 0.015 in. on each side. Greater clearance allows the material to wash back over the screw, resulting in loss of extrusion pressure and consequent slow and non-uniform delivery. If too much material washes back, the stock may not be delivered to the die.

Optimum rotational speed of the screw varies for different plastic compounds as well as for various die shapes and sizes. For this reason variable speed drives are most desirable. In general, the preferred screw speed for processing vinyl resin is 12 to 30 r.p.m.—considerably lower than that used in the extrusion of other thermoplastic materials.

Since the screw and barrel in this machine must withstand severe mechanical forces, the materials used in the construction of these parts are of special importance. To avoid possible decomposition of the stock, materials which would have a catalytic effect on the compound cannot be used. For this reason it is desirable that cylinders be made of Hastelloy nickel-molybdenum-iron alloy B, or of hardened corrosion-resistant alloys having a Rockwell hardness on the C scale of about 68. The cylinder wall should not be chromium plated as such plating may chip off and score the cylinder or screw. Stainless steel, or a similar tough, rigid steel may be used to fabricate the screw. This part may be chromium plated on all of the frictional areas, but not on the lands that contact the walls. It is important to have the lands hard-faced with a material such as Haynes Stellite cobalt-chromium-tungsten alloy.

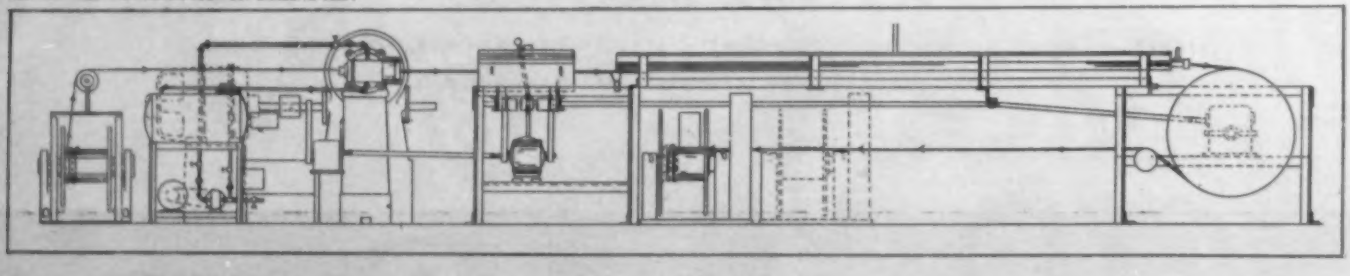
Breaker plates and screens

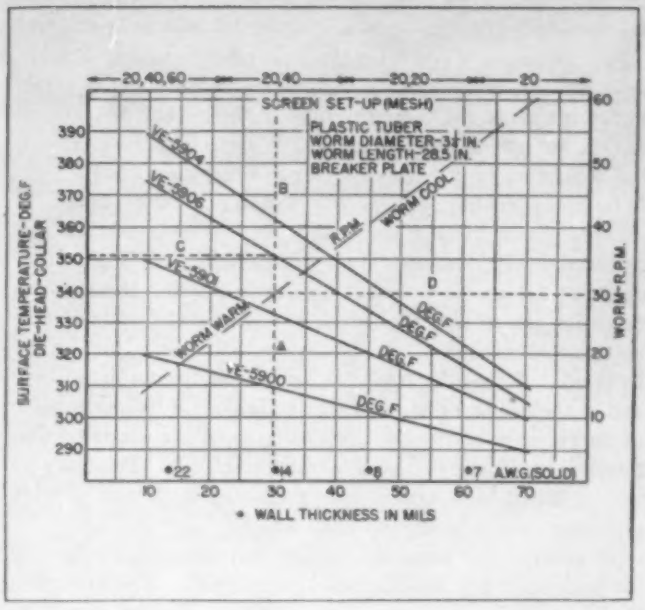
To effect uniform plasticization of material passing through the plastic extruder, it is usually desirable to use breaker plates and screens. This is permissible with plasticized vinyl resins because of their fundamental flow behavior. However, these plates and screens are not used with unplasticized vinyl materials.

* Bakelite Corp.

1—Auxiliary equipment used with this typical setup for resin insulation of wire and cable includes facilities for heating wire before it passes through the extruder, an annealing oven for extruded product and a cooling trough

ALL DRAWINGS AND PHOTOS COURTESY BAKELITE CORP.





2

3

2—A typical screen setup with the corresponding compound temperature and worm speed which applies to a plastic extruder with a worm 3¼ in. in diameter and 28½ in. long. 3—The general practice for the extrusion of rods, tubing and other shapes is for the straight head of the machine to deliver the material directly to the belt

The size and design of the breaker plate depend, of course, on the make and size of the tuber. A 4-in. diameter strainer plate with a $3^1/_4$-in. working diameter will produce good results when used in a machine with a $3^1/_4$-in. diameter screw. This plate may have thirty-six $^3/_8$-in. or ninety-six $^1/_8$-in. diameter holes, which should be uniformly spaced. The strainer plate may be chromium plated.

Screens of various mesh and wire sizes can be used in combination with the breaker plate. One 20-mesh steel-wire screen used with the breaker plate helps to assure satisfactory delivery speeds and the production of high quality tubing for the larger sizes. Although finer screens tend to cut down the delivery rate, screens up to 60 mesh can be used with the coarser mesh screens when extruding a thin wall without loss of head pressure or the sacrifice of tubing speed. Figure 2 shows a typical screen setup which corresponds to the temperature of the compound and the worm speed. This setup will vary with each type of extruder, so these data are only indicative of the relationship to be determined.

To conserve the thermal life of the compound, it is often desirable to bleed excess material from the system through an auxiliary valve in the die holder or head. Bleeding of the stock is especially desirable where a large cylinder may be called upon to extrude tubes of small cross section, or where the amount of material in the system is very large in relation to the delivery rate.

Die design and construction

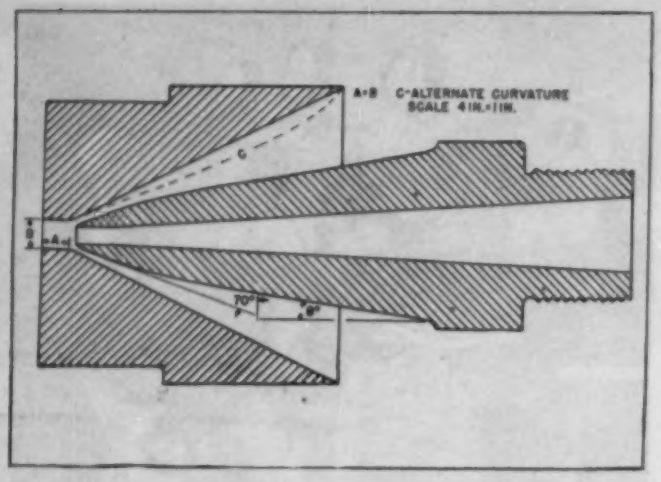
The delivery head—particularly the side delivery head—and the die design have been greatly improved in recent years. While compound space in the head has been more fully streamlined, a need seems to exist for still further redesign directed toward the correlation of the effect of compound space on the back pressure in the barrel for different size tubers. Dead spots in the head should be eliminated.

In designing the dies, it should be remembered that expansion of the compound will take place as soon as the stock leaves the die—the exact percentage of the expansion depending upon the length and shape of the die. Drawing the product through the die at a rate of speed higher than the extrusion speed will cause stretching of the product. This controlled stretching compensates for the expansion and aids in controlling size. A variable speed drive is of value in setting this controlled stretch and provides means for accommodating naturally variable extrusion rates. The necking down, or stretching, of the compound at the die improves the surface finish. The diameter of a die is usually 3 to 5 percent greater than the diameter of the insulation which is to be extruded.

Figure 4 illustrates the relationship of the bearing length (or parallel proportion) of the forming die to the diameter of the die for sizes up to $^1/_2$-in. diameter. In general, in these smaller sizes, the bearing length of the formative die is the same as the diameter of the die. For dies with a greater diameter, a maximum bearing length of $^1/_2$ in. is frequently used.

For rods and profiles of average size, a parallel die length of $1^1/_2$ to $2^1/_2$ in. has been found satisfactory—a measurement which does not include the streamlined entrance to the actual forming surfaces. When doubt exists, it is best to make the die the maximum length and, if necessary, reduce as indicated by trial. On the basis of a $2^1/_2$-in. die length, an expansion of approximately 25 percent of the die size may be expected in the extruded product. This means a $^1/_4$-in. round die would deliver an extruded rod 0.25 + (0.25 by 0.25) or 0.312 in. in diameter.

In extruding shapes with cross-sectional areas that are small in relation to the capacity of the extruding machine, it is often desirable to design dies 30 to 50 percent oversize and rely on stretching the product to the required diameter to obtain dimensional control. This procedure increases the extruder output over that which would be obtained if a die of smaller cross-sectional area were used and the product stretched correspondingly less. In applying this principle to non-circular shapes, especially where there is a relatively large difference between horizontal and vertical dimensions, a word of caution is in order. The reduction in width which results from stretching is generally proportionately greater than the reduction in thickness. The ratio of this difference in dimen-



4—Bearing length of a forming die is the same as the diameter of the die for sizes up to ½ in. in diameter

sions, dependent on the geometry of the die section, is determined by trial and error, or from experience with similar extruded shapes.

In the extrusion of tubing, specially thin wall tubing of 0.025 in. or less, dies of ½-in. forming length are used. Shorter dies are used for tubing than for solid shapes since the resistance of the stock to movement is greater in such thin sections. Here again, an expansion value of 25 percent of the die diameter may be employed for die design purposes.

All extrusion dies for use with thermoplastic resin materials should be designed to include a carefully streamlined entrance. Tool steel—hardened and polished to a mirror finish on the die forming surfaces—has been found satisfactory; non-ferrous metals should not be employed because of catalytic decomposition effects of such metals on the compounds. Dies should be hardened—after they have been tried and adjusted with respect to the size of the extruded product—to protect them from damage. The entrance and forming surfaces should be plated with 0.001 to 0.002 in. of hard chromium-plate. This plating should also be polished to a mirror finish to eliminate sticking of the material in the die and improve the surface finish on the product.

In the extrusion of tubing stocks, it is often highly desirable to obtain exact control of the diametrical size of the tubing and preserve perfect roundness. This is best accomplished by passing the tubing through a circular cooling die—external to the extruder—and inflating the tubing to the size of the cooling die by sealing the end of the tubing and passing carefully adjusted and accurately controlled low-pressure air into it through the extrusion pin. Usually extruders are equipped with facilities for passing the necessary air through the extrusion pin.

When designing extrusion dies to be used in conjunction with cooling dies, provision should be made for an approximate 50 percent increase in the diameter of the tubing. This will compensate for a diameter increase of roughly 25 percent as the result of blowing and a natural expansion of roughly 25 percent which is experienced by the material as it leaves the extrusion die. Most successful cooling-die operation is obtained when the material is expanded to size rather than stretched to size.

Cooling dies should be 8 to 10 in. long and may be made from brass or other suitable material. These dies should be mounted in a jacket through which water, or other coolant, can be freely circulated. The internal or working surfaces of the dies should be very carefully machined so as to be smooth, of uniform size and free from any undercuts or taper. Roughness of surfaces causes trouble from excessive drag while undercuts cause the tubing to bind in the cooling die. Cooling die entrances should be "belled" out on a radius of not less than 1 in. to provide easy entrance for the tubing.

In using cooling dies, the uninflated tubing should be quickly passed through the cooling die, the end sealed off and fastened to the conveyor belt with a weight or some other device. Air pressure should be slowly applied through the extrusion pin so that the tubing is just brought up to die size and not overinflated. Overinflation will cause the tubing to break. When the tubing is cut to length at the delivery end of the conveyor, it must first be sealed off to prevent loss of air pressure and consequent collapse of the extruded material between the extrusion and cooling dies. This may be accomplished by a heat-sealing tool, such as a pair of wide grip pliers which have been heated to 130° C.

In general, the foregoing data on extrusion dies hold true for both rigid and flexible vinyl compounds. The exception is the parallel or forming length of dies needed for extruding the latter materials. In sizes up to ⅜-in. outside diameter of finished coated wire or extruded tubing, good speeds and surface are obtained when the forming length of die is about equal to the die diameter. In sizes over ⅜ in. in diameter, the parallel length of the die may be reduced to ¼ to ½ of the die's diameter.

Temperature control

Vinyl resins are characterized by a definite thermal life which may be expressed as a function of time and temperature as interdependent variables. This life is many times greater than is normally expended in the process of extrusion. Under conditions of thermal abuse, however, the material will start to decompose with resultant evolution of hydrogen chloride. This decomposition stage is indicated by a brown to black discoloration in the extruded product, the development of a sharp acrid odor of the product, or both these conditions. There is no flammability or explosion hazard involved, however. Evidence of decomposition indicates that either the material is being subjected to an abnormal temperature condition somewhere in the extruder or it is being exposed for too long a time to normal extrusion temperatures. Open joints between fitting members, pockets, abrupt shoulders in the path of resin flow, particularly in the head and die holder, will all cause stagnation of small quantities of material which in turn will result in decomposition.

Consequently, thorough streamlining of all internal parts of the extruder and the elimination of all pockets where the material might stagnate is most desirable and it is for this same reason that the use of breaker plates and screens, which are difficult to streamline properly, is not recommended for the extrusion of rigid-type vinyl resin compounds, although their use is desirable when plasticized compound is extruded.

The barrel of an extruder is usually divided, for temperature control purposes, into two zones of approximately equal length. Some machines include a water jacket for cooling the feed opening to prevent "bridging" of the feed material at that point. In addition, some machines provide for separate temperature control at the head or in the region between the delivery end of the screw and the die holder.

Steam or hot oil is the customary means of heating the barrel. Where steam is used, accurate differential temperature control on various parts of the machine may be effected through the use of pressure-regulating devices. If

circulating oil from a common source is used, a less satisfactory differential temperature control on the various extruder parts is obtained by throttling the inlet valves of the various parts to the desired point. Some machines obviate the disadvantages of this latter method by incorporating separate circulating oil systems, with temperature controllers on each system, for the different parts of the machine.

Rigid-type compounds—These materials are supplied in granular form with the size of the grains not exceeding $^{7}/_{16}$ in. Temperatures given in the succeeding paragraphs are predicated on the use of this type of feed. It has been found desirable, where machine construction permits, to operate with sufficient water on the feed magazine jacket to render it cool to the hand.

The feed end zone of the barrel should be maintained at 65 to 93° C. (149 to 199° F.), and the delivery end zone of the barrel at 120 to 130° C. (248 to 266° F.). Where control is provided on the head, this temperature should also be held at 120 to 130° C. (248 to 266° F.).

The die and die holder should be maintained at 155 to 165° C. (311 to 329° F.). High die temperatures give optimum results in surface finish of the extruded product. Some machines do not provide facilities for heating the die. In such cases, electrical strip heaters which fit closely over the parallel sides of the die holder are recommended. These strip heaters should be equipped with automatic temperature controllers, rheostats and pyrometers or with some means for accurate control of the die temperature, since variation in this temperature will cause irregularities in extrusion rate and surface finish.

The internal surfaces of the die holder which are in contact with resin compounds should be chromium-plated with 0.001 to 0.002 in. of hard chromium-plating. This conserves the thermal life of the material by eliminating sticking and burning in the holder area.

The screw temperature should be maintained at 120 to 130° C. (248 to 266° F.). Control cannot, however, be properly maintained by the use of electrical heaters in the screw. This is due to the heat of friction which gradually builds up the temperature in this member, causing it to exceed the recommended temperature.

On electrically heated screws presently in existence, good results have been obtained by removing the heating element, inserting a small steel tube which extends to the delivery end of the screw and passing air at a slow rate through the tube. This arrangement permits the air to exhaust into the open on return; it eliminates the build-up of a high temperature on the end of the screw which otherwise would cause the material to burn in that area.

On screws designed for steam or hot oil heating, the recommended screw temperature can be easily maintained since the circulating medium serves to warm the screw in the initial stages of operation and, after the frictional temperature build-up starts, serves to cool the screw to the proper temperature, thus maintaining a balanced temperature.

Flexible-type compounds—These materials are supplied in strip or, in some cases, granular form, about 0.035 in. thick, $3^{3}/_{4}$ in. wide, and from 40 to 50 in. long. For ease of handling it may also be supplied in continuous rolls. In both forms the materials are fed to the tuber at room temperature.

To obtain maximum extrusion speeds and for the reasons previously described, it is desirable that a temperature gradient be maintained throughout the various sections of the tuber. The feed end of the barrel should be held at 80 to 100° C. (176 to 212° F.), delivery end zone at 100 to 125° C. (212 to 257° F.), breaker plate section at 135 to 145° C. (293 to 302° F.) and die at 155 to 165° C. (311 to 329° F.). No heat need be applied to the screw at any time. Decrease in extrusion speeds while temperatures of the various sections are maintained usually indicates that the screw is becoming too hot from frictional heat. For such a contingency, it is desirable that provision be made for water cooling of the screw. Care must be exercised, however, since too rapid and too much cooling will cause the compound to "freeze" around the screw, stopping delivery.

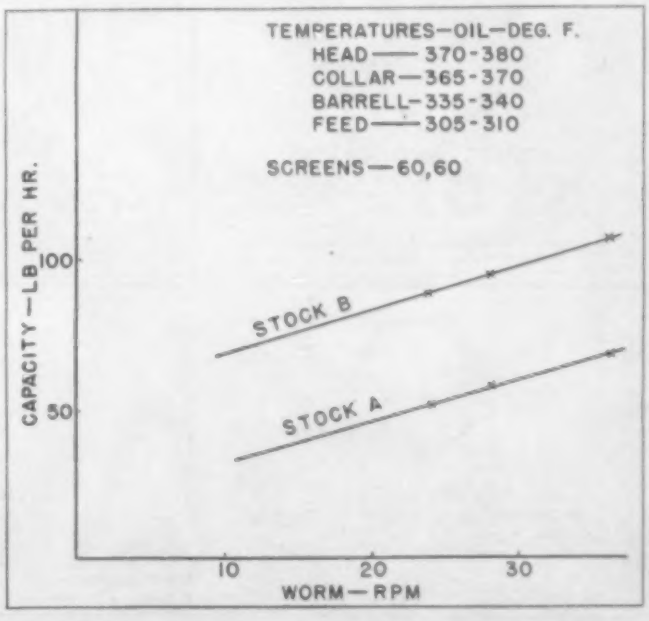
Feeding the extruder

A convenient method of feeding the strip material to the tuber is to place the rolls of tape on a mandrel near the magazine and allow the worm to draw the material into the machine. Care must be taken to insure that sufficient material is taken up at all times. The mixing of hot and cold compounds must be avoided since such a procedure will result in variations in extrusion pressures and cause wide variations in size and residual strains in the extruded product. This point is of particular importance in feeding back overflow stock from the bleeder. The collected overflow of materials should not be mixed immediately with room-temperature stock that is being fed to the machine.

In cold feeding a tuber having a worm of approximately $3^{1}/_{4}$-in. diameter, maximum efficiency is usually reached when the tube being extruded has a wall of $^{3}/_{64}$ inch. When extruding larger sized tubes, it is often necessary to preheat the compound on a two-roll mill in order to increase the tubing capacity. (There is little advantage to be gained from using a warm-up mill when extruding the smaller sizes.) For the insulation of larger size wires or jacketing cables ranging from 0.5 to 5 in. in outside diameter, a plastics extruder with a worm approximately 6 in. in diameter is used. The larger machines are similar to the smaller in that the capacity can be increased 200 to 300 percent by preheating the stock.

The recommended temperature of the mill for the softer vinyl stocks is 220° F. For the stiffer compounds, the surface temperature of the mill should be in the neighborhood of 266° F. However, when tested with (*Please turn to page 180*)

5—*Graph of the effect of worm speed under set temperature conditions on capacity of the extrusion machine*



HERE'S THE KEY TO BIG BUSINESS IN THE POSTWAR

Probably every office in America today needs one or more new business machines or pieces of office equipment.

When they are available again, the manufacturer who offers the most in new designed-for-doing efficiency is going to get the most of that business.

And to get it, the manufacturer is going to use plastics. He's going to use plastics liberally and correctly in structural parts, in semi-structural parts, in operating components and for smooth, integrated styling. With plastics, he will provide modern office tools improved in performance, improved in appearance, and lowered in costs.

Suggested in the charts here are the Monsanto plastics that will best provide these important qualities for a variety of postwar office appliances. Further information or counsel is always at your command through Monsanto's plastics consultants. They will give you experienced, disinterested advice based on the broadest and most versatile group of plastics offered by any manufacturer in the industry.

Write, wire or phone: MONSANTO CHEMICAL COMPANY, Plastics Division, Springfield, Massachusetts.

FILES

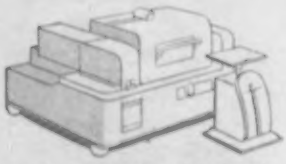
Panels — Thalid impression moldings
Handles, card holders — Molded Lustron, Fibestos, Resinox
Index pads — Nitron, Fibestos

CASH REGISTERS

Numbers, keys — Molded Fibestos, Nitron, Cerex
Housings, drawers — Thalid impression moldings

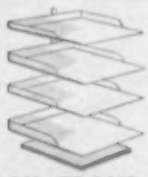
COMMUNICATIONS

Insulated parts — Styramic HT, Resinox, Cerex, Lustron
Grills — Fibestos, Lustron, Resinox
Housings — Resimene, Resinox, Cerex
Controls — Lustron, Fibestos, Resinox



SCALES AND METERS

Housings — Molded Resinox, Resimene or Thalid impression moldings
Crystals — Molded Lustron or Fibestos sheets
Dials — Printed scales—Fibestos sheets
Molded scales — Lustron



MAIL TRAYS

Trays — Thalid impression moldings
Fittings — Molded Lustron, Fibestos, Resinox, Resimene

PROTECTIVE COVERS

Hoods and covers for machines — Monsanto vinyl butyral fabric coatings

TYPEWRITERS

Enclosures—Molded Resimene, Resinox
Knobs, keys — Nitron, Fibestos
Platen — Transparent, molded vinyl acetal

LIGHTING

Incandescent shades, bases — Cerex, Resimene, Resinox
Fluorescent shields—Vuelite or Lustron diffusing panels
Molded parts — Lustron, Fibestos, Resinox

PENCIL SHARPENERS

Housing for automatic type — Resinox, Resimene
Shavings box — Molded Fibestos

BUSINESS MACHINES MARKET

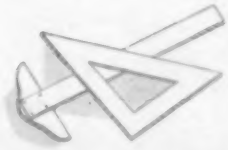
MONSANTO PLASTICS FOR BUSINESS MACHINES

	Tensile Strength	Impact Resistance	Heat Resistance	Dimensional Stability	Color Range	Forms* Supplied	Molding** Methods
CEREX (heat-resistant thermoplastics)	good	good	to 230°F.	excellent	extensive	MC	I, C, E
FIBESTOS (cellulose acetates)	good to excellent	excellent	to 120—212°F.	fair to good	unlimited	MC, S, R, T	I, C, E
LUSTRON (polystyrene)	good	good	to 180°F.	excellent	unlimited	MC	I, C, E
NITRON (cellulose nitrates)	very good	excellent	to 140°F.	good	unlimited	S, R, T	Special methods
RESIMENE (melamine-formaldehydes)	very good to excellent	good	to 210—380°F.	excellent	all but lightest colors	MC, IR	C, T
RESINOX (phenol-formaldehydes)	good to very good	good to excellent	to 230—450°F.	excellent	darker colors only	MC, IR	C, T
VINYL ACETALS	rubber-like compounds are supplied in both thermoplastic and thermosetting (vulcanizable) forms, are used primarily as fabric coatings and adhesives but can also be extruded in limitless range of colors.						
THALID	Completely reactive thermosetting resin for impression molding. Impregnates glass cloth, other fabrics, or paper to make large, rigid panels or forms of high strength. (Ask for special bulletin on Thalid.)						

*MC—molding compounds S—sheets R—rods T—tubes IR—industrial resins
**I—injection C—compression E—extrusion T—transfer, form of compression

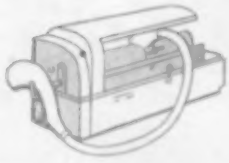
CALCULATORS

Housings — Thalid impression molding, Molded Resimene, Resinox
Keys, knobs — Lustron, Fibestos, Nitron



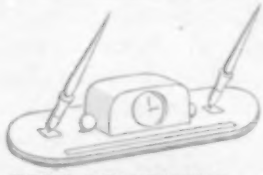
DRAWING EQUIPMENT

Molded Parts — Resinox, Lustron, Resimene
Triangles, squares, circles — Nitron, Fibestos



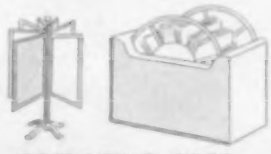
DICTATING MACHINES

Housing — Molded Resinox, Resimene, Thalid impression molding
Controls — Molded Lustron, Fibestos
Mouthpiece — Molded Resinox, Resimene, Lustron



DESK EQUIPMENT

Fountain pens, pencils, etc. — Pearl Nitron, Fibestos, Molded Resinox, Lustron
Address finders, etc. — Molded Resinox, Lustron, Fibestos, Transparent Fibestos sheets



OPERATING FILES

Housings — Molded Resinox, Resimene, Thalid impression moldings
Card covers, tabs, etc — Fibestos, Nitron sheets

FURNISHINGS

Draperies — Vinyl butyral coated fabrics
Wall coverings — Vinyl butyral coated papers
Glazing in doors, partitions, etc. — Reinforced Vuelite
Venetian blinds — Thalid impression moldings, Resimene laminates

The large and versatile family of Monsanto Plastics includes: Lustron polystyrenes Cerex heat resistant thermoplastics • Vinyl acetals • Nitron cellulose nitrates • Fibestos cellulose acetates • Resinox phenolics • Resimene melamines. Forms in which they are supplied include: Sheets • Rods • Tubes • Molding Compounds • Industrial Resins • Coating Compounds • Vuepak rigid, transparent packaging materials.

MONSANTO PLASTICS
SERVING INDUSTRY WHICH SERVES MANKIND

1

Cabin structure for R-6 war helicopter

LAMINATED plastics have been called upon to take on an important new war job—construction of the cabin structure of the new R–6 war helicopter. This aircraft which promises to be invaluable for rescuing aviators downed at sea, picking up and transporting wounded from inaccessible combat areas and servicing outlying military stations with needed supplies, now uses glass fiber laminate for this front section of the fuselage.

Development of helicopter

The development of the helicopter has come a long way since Igor Sikorsky first took off from the ground in his new machine, which required no running start, and proceeded to prove to the world that, at will, this plane could hover motionless in the air. One of the greatest improvements in the newer helicopter models is a greatly increased load capacity. While still somewhat more difficult to fly than the typical airplane, present helicopters have control systems which are so improved in design that the average pilot needs only a minimum of training at the controls to be able to handle the ship successfully. One of the biggest advances, of course, is the load carrying capacity of the R–6—a factor which makes any reduction in the over-all weight of the machine, no matter how minor it may be, highly desirable if the helicopter is to function with maximum effectiveness.

This question of weight, plus several other factors, prompted the Sikorsky Aircraft Div. of United Aircraft Corp. to discuss with Mr. Swedlow the possibility of replacing aluminum structural portions of the R–6 cabin, which comprises all sections of the helicopter ahead of the stainless steel fire wall, with some type of plastic material. Out of this discussion came a recommendation that Swedlow Aeroplastics Corp. be asked to undertake the development work for such a structure using a glass fiber laminate.

Advantages of plastics parts

In addition to enjoying a small weight saving by the switch from aluminum to laminated glass fibers, the helicopter has also benefited from the material's sound deadening and noise elimination properties. One reason for this reduction in noise level is the fact that while the metal cabin structure was made up of several hundred separate parts all riveted together, the final plastic design called for a major assembly comprising but 26 minor assemblies. A number of these assemblies were glued together and the remainder of them tightly riveted. The result was a compact, uncomplicated structure.

Only a very short time elapsed between the origination of the idea of a plastic cabin structure and the A.A.F. award of a supplementary contract to Sikorsky for this change. Notice of this award was immediately forwarded to a West Coast laminator together with complete engineering drawings for the metal cabin as it was then constructed. The fact of the matter was that design and engineering work had been completed for a metal structure, but no work of any kind had been undertaken to engineer this cabin structure properly in laminated materials.

When the Sikorsky blueprints of the metal cabin were first inspected, the molder immediately came to the conclusion that while the cabin could be constructed of plastic laminates, hand fabrication would be necessary unless a great number of the component parts could be combined. This in itself presented a tremendous problem and all effort, therefore, was directed toward redesigning the cabin so that it could be made in as few parts as possible. The result was a major assembly

comprising but 26 minor assemblies and vastly simplified component parts.

Because of the limited time available for this work, all possible shortcuts were utilized. For this reason, the tooling was built of wood backed with metal. Working directly from the revised blueprints of the cabin, the laminator first made a plaster mockup. Subsequently, all necessary measurements were taken from this mockup. Where it was necessary to have deep hat sections, vacuum bags were used over the male molds. In other cases, male and female molds of metal-backed wood were used. The greater part of the assembly, however, was made on very simple male molds. So cleverly designed were these molds that the necessary hat sections could be formed by them and were supplemented by tie strips that were formed on the under or reverse side of the form. The problem of attachments for the acrylic windows was quickly solved by building all necessary joggles into the hat section molds.

Method of fabrication

The method of fabricating the parts of the helicopter cabin structure was very simple. The fabrics were laid up on the male molds in such a manner that the maximum efficiency of the glass fiber laminate was utilized. A variety of methods was used to hold the layups in place during the cure.

Of course, the building of the mockup and the designing of tools consumed the most time—the actual time required to fabricate the parts being but two weeks. The 26 assemblies were then put together by a combination of cementing and riveting and the cabin checked against the original mockup. The glass fiber laminated structure was found to correspond very closely to the model so that only minor changes had to be made by Sikorsky Aircraft when attaching the unit to the plane. A review of the assembly after its completion showed that a considerable number of the structural members had more than the required strength. Additional weight could have been saved by reducing the thickness of the laminates

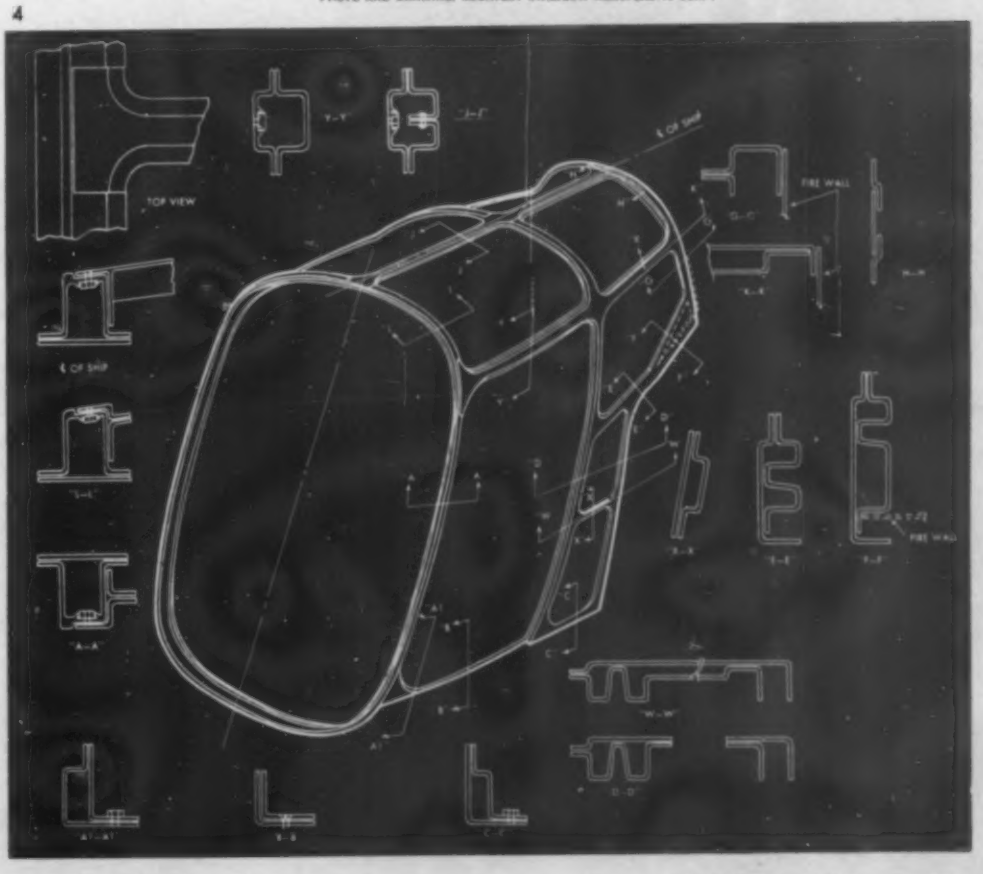
PHOTO, COURTESY UNITED AIRCRAFT CORP.

2

3

PHOTO AND DRAWING, COURTESY SWEDLOW AEROPLASTIC CORP.

4



1—This newest version of the Sikorsky helicopter, a 2-place military model, is to be built for the Materiel Command of the U. S. Army Air Forces. 2 and 3—By using laminated glass fibers instead of aluminum in the construction of the cabin structure of the new R-6 war helicopter, the company effected a 15 percent saving in weight. 4—A proposed parts drawing for the cabin structure of this new helicopter

5

6

and also their size. However, even as constructed, a considerable weight margin exists between the completed glass fiber laminated cabin and the assembly from which the redesign was made. Another advantage which accrued to this operation was that it was easy to smooth out layers of the cabin in general, in this way giving a very pleasing appearance to the finished contours.

The laminator states that the final cabin designs, which have been developed for full-scale production, are greatly simplified, and estimates that the comparative man hours projected on a production basis for both the metal and plastic cabin structure would give the advantage to the glass fiber laminated cabin structure by approximately 50 percent over that of the metal.

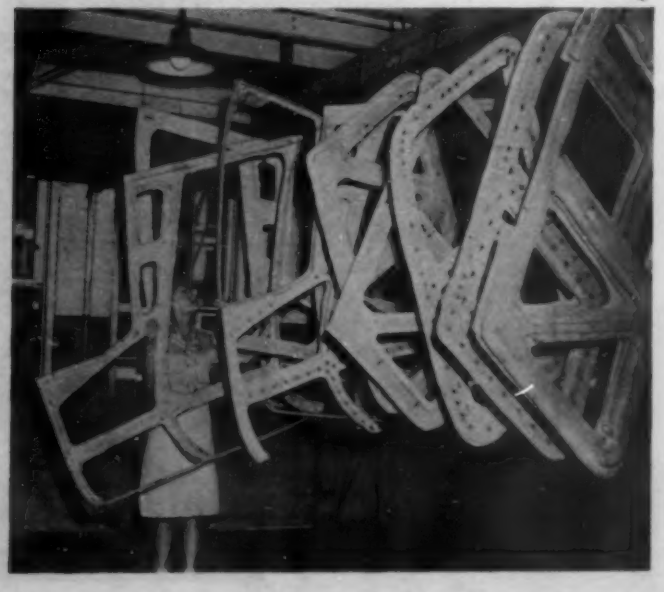
It is reassuring to have concrete evidence that there are far-seeing engineers in both the aircraft and plastics industry and that, while these men do not go completely overboard with regard to the use of plastics materials in aircraft, they do realize that there are many structural parts in these machines which can be markedly improved by the use of the proper plastics material. This helicopter is now being built to Sikorsky designs by Nash-Kelvinator Corp., and the cabin structure is now in full-scale production at the Mishawaka, Indiana, Plant of the U. S. Rubber Co.

Credits—Material: Cabin structural sections, Fiberglas bonded with low-pressure contact-type resin. Deep drawn section of nose, Plexiglas. All other transparent enclosures, Lucite.

5—The problem of working out suitable attachments for the acrylic windows was quickly solved by building all necessary joggles into the hat section molds. 6—Use of laminated glass fibers for the cabin structure was found to somewhat deaden the sound of the engine. In addition, the problems of vibration were overcome when this material was used in place of aluminum which has a natural period of vibration equal to that set up by the engines when in operation. 7—This new cabin structure is so light in weight that it can easily be picked up and carried by a woman. 8—The final plastic design of the cabin structure of the helicopter called for a major assembly comprising but 26 minor assemblies. Here a worker hangs up a partially processed side panel

PHOTO NO. 5, COURTESY SWEDLOW AEROPLASTICS CORP.
PHOTO NO. 6, COURTESY UNITED AIRCRAFT CORP.
PHOTOS NO. 7 AND 8, COURTESY UNITED STATES RUBBER CO.

7



8

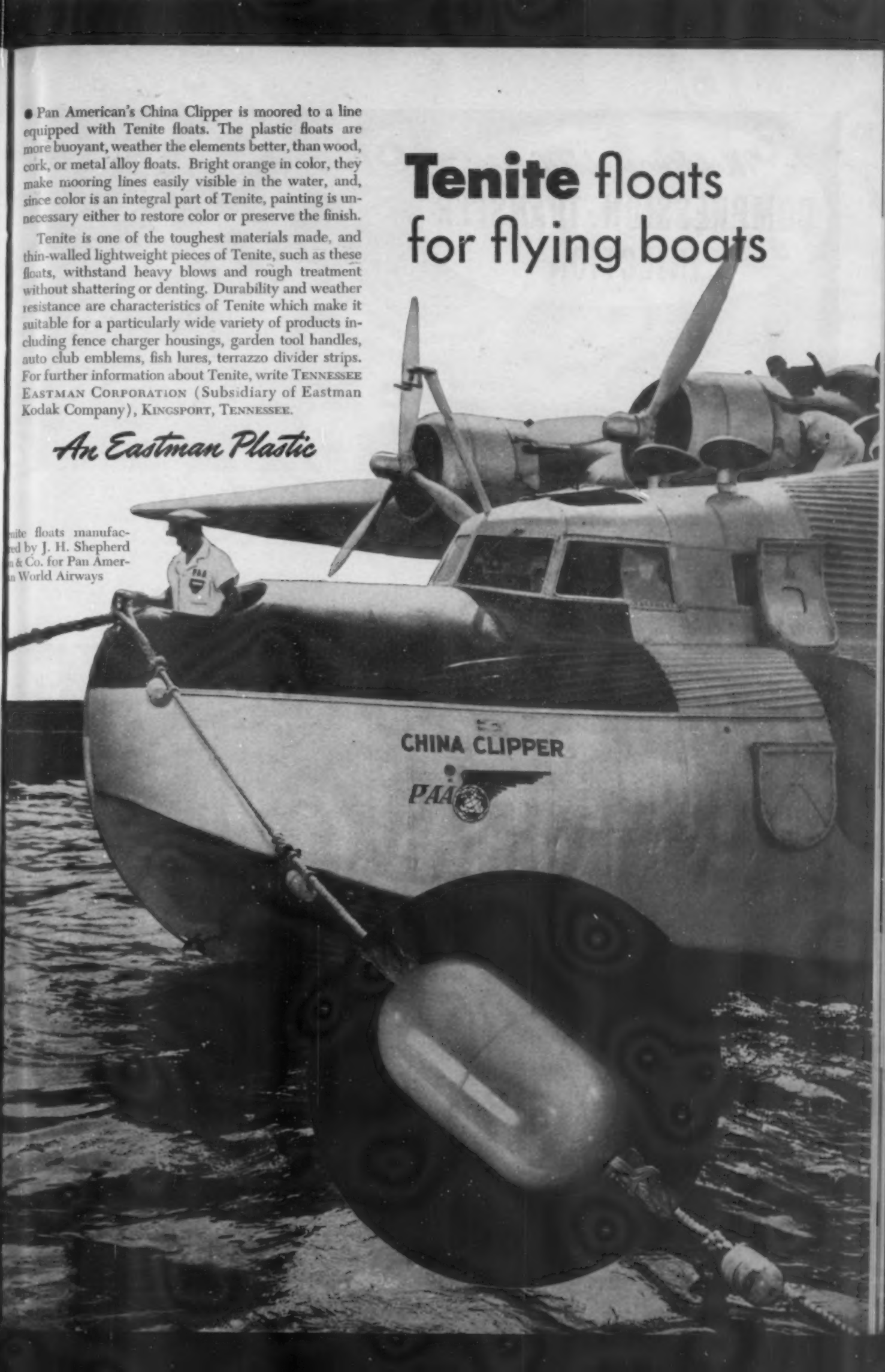
Tenite floats for flying boats

● Pan American's China Clipper is moored to a line equipped with Tenite floats. The plastic floats are more buoyant, weather the elements better, than wood, cork, or metal alloy floats. Bright orange in color, they make mooring lines easily visible in the water, and, since color is an integral part of Tenite, painting is unnecessary either to restore color or preserve the finish.

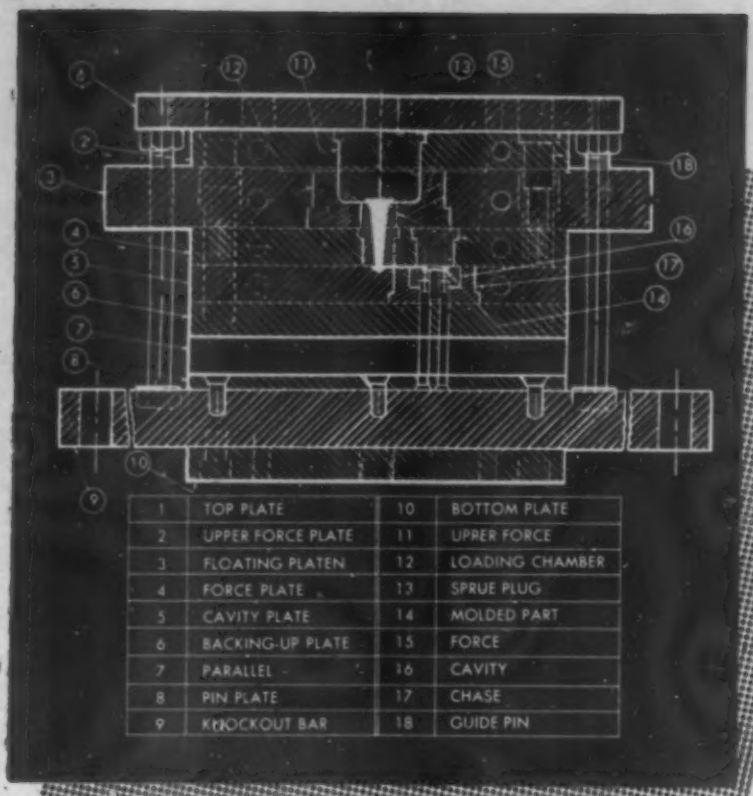
Tenite is one of the toughest materials made, and thin-walled lightweight pieces of Tenite, such as these floats, withstand heavy blows and rough treatment without shattering or denting. Durability and weather resistance are characteristics of Tenite which make it suitable for a particularly wide variety of products including fence charger housings, garden tool handles, auto club emblems, fish lures, terrazzo divider strips. For further information about Tenite, write TENNESSEE EASTMAN CORPORATION (Subsidiary of Eastman Kodak Company), KINGSPORT, TENNESSEE.

An Eastman Plastic

nite floats manufac-
ed by J. H. Shepherd
n & Co. for Pan Amer-
n World Airways



NUMBER 18 IN A SERIES OF EDUCATIONAL ADVERTISEMENTS ON TRANSFER MOLDING



1	TOP PLATE	10	BOTTOM PLATE
2	UPPER FORCE PLATE	11	UPRER FORCE
3	FLOATING PLATEN	12	LOADING CHAMBER
4	FORCE PLATE	13	SPRUE PLUG
5	CAVITY PLATE	14	MOLDED PART
6	BACKING-UP PLATE	15	FORCE
7	PARALLEL	16	CAVITY
8	PIN PLATE	17	CHASE
9	KNOCKOUT BAR	18	GUIDE PIN

FOR LOW COST MOLDING

"Transfer" Molding was developed originally to provide a means for the molding of complex products that could not be produced easily by the compression molding process. Improved preheating and molding methods have expanded greatly the fields for "Transfer" molding. Many leading molders are now using "Transfer" molding for all thermosetting production because it gives them **lowest part cost** in addition to improved quality and dimensional control.

Using the "Pressure" type of "Transfer" mold with high frequency preheating, you can get amazingly fast production, best quality control, intricate moldings, minimum mold wear and minimum equipment investment per piece produced per hour.

TRANSFER MOLDING is the best way to

Handle inserts—metal, glass, ceramic
Mold high-impact materials
Mold unsupported cores
Achieve maximum dimensional accuracy
Reduce trapped gases
Lower mold costs
Lengthen mold life
Increase molding speed
Reduce finishing costs
Improve uniformity of cure regardless of cross-section
Save material by eliminating flash
Get practical solution to difficult molding problems
—on thermosetting plastics.

SHAW INSULATOR CO.

IRVINGTON SHAW NEW JERSEY

CONTROL!

CLAREMONT FILLERS MAKE STRONGER PLASTICS...

. . . And Better Plastics! These clean, uniform cotton ingredients impart increased tensile, impact and flexural strength. Their use in the form of graded flock, cord or thread lengths or fabric particles, follows a prescribed quantity pattern that enables adherence to and compliance with the most exacting specifications. We invite plastics materials manufacturers and compounders to investigate these extra-added-strength factors. They strike a well of new applications for plastics products.

CLAREMONT MANUFACTURING CO.
CLAREMONT, NEW HAMPSHIRE

The Counry's Largest Manufacturers of Flock and Fabric Fillers

Effect of environment on permanence of acetate and nitrate sheets*

by T. S. LAWTON, JR., and H. K. NASON**

THE use of plastics in engineering applications has been accentuated because of the demand for these materials by the Armed Forces. For the intelligent engineering application of any material, a knowledge of its properties under all environmental conditions which may be encountered in service is essential. A summary of recent progress in this field has been published from this laboratory(1).[1]

Such data on cellulose acetate and cellulose nitrate have been scarce until recently when a paper describing the effect of environmental conditions on the mechanical properties of cellulose acetate and cellulose nitrate was published from this laboratory (2). The work reported herewith covers the effect of environmental conditions, such as weathering, ultraviolet light exposure, moisture exposure, heat exposure, etc., on the permanence of cellulose acetate and nitrate plastic sheets.

Materials

The cellulose acetate sheets used in this investigation were 2050 TVA Fibestos.[2] They were manufactured by the sheeter process (3, 4), and the surfaces were given an "HH" (polished) finish in a planish press under the conditions customarily employed for such materials. The residual solvent and water content was less than 1.5 percent as received. These materials are of the type customarily furnished for transparent enclosures on aircraft and similar applications, and meet all requirements of Air Corps Specification 12025-B (5), Navy Aeronautical Specification P-41c (6) and A.S.T.M. Specification D 786–44 T (7). These materials are of the same composition as those studied by Findley (8, 9, 10).

The cellulose nitrate sheets were manufactured from medium viscosity pyroxylin of approximately 11 percent nitrogen content, and were plasticized with approximately 25 percent camphor. Processing was by the sheeter method and was similar to that employed for the cellulose acetate sheets. Residual solvent and water content was less than 1 percent as received. These materials meet all requirements of A.S.T.M. D 701–44 T, Type 1 (11), U. S. Army Specification 95-12008B (12) and Federal Specification GG-T-G71 (13). All materials were taken from regular production lots.

Test procedures

Wherever possible, A.S.T.M. standard test methods were used, and specific references to test methods are given in the text. The apparatus used has been described previously (2).

The desired number of test specimens were cut from a single plastic sheet and mixed thoroughly to minimize geometric variables. All specimens were preconditioned for 48 hr. at 50° C. (122° F.) to eliminate moisture, and were stored in a desiccator over anhydrous calcium chloride until needed. All tests were made at 25° C. (122° F.) and 50 percent relative humidity, unless noted otherwise.

The outdoor weathering panels were exposed both in Miami, Fla., starting January 1942, and in Springfield, Mass., starting December 1941, at 45° to the vertical and facing south. The panels were not confined in a frame, but were supported on the edges only. After the desired exposure time, the panels were rinsed lightly with warm water to remove all surface dirt and other extraneous matter. The test specimens were then cut out of the 12 by 12-in. exposed panels.

To determine the effect of ultraviolet exposure on the permanence of these materials, test specimens were exposed under a General Electric S-1 sunlamp as specified in A.S.T.M. D 620–41 T (14), at a distance of six inches from the bottom of the bulb. Specimens were so placed on the turntable that each received the same light intensity. Only S-1 bulbs which had been burned more than 50 and less than 500 hr. were used. To determine the effect of heat on the permanence properties, specimens were exposed in a circulating-air oven operating at 50° C. Reported values represent the arithmetic mean of at least five determinations, and the plus or minus limits shown represent the arithmetic mean deviation of the individual values from the mean.

General effects of weather exposure

The general effects of outdoor exposure on cellulose ester plastics may be summarized as follows:

1. The base cellulose ester is degraded. Both saponification and molecular degradation due to breaking of the cellulose chain, with the formation of lower molecular weight fractions, may occur. The latter reaction is usually the more important; the extent of saponification is different for different cellulose esters. Thus, considerable denitration of cellulose nitrate takes place during weathering, but relatively little deacetylation of cellulose acetate has been observed. The degree of degradation is dependent upon the length of exposure and upon the intensity of the incident radiation.
2. Plasticizer is lost by evaporation and by leaching.
3. The color of the material may be changed due to darkening or bleaching of added colorants or, in the case of plastics containing no added color, to darkening or bleaching of the plastic material itself. Uncolored cellulose acetate plastics

---

* Presented before the Rubber and Plastics Division at the Annual Meeting of the American Society of Mechanical Engineers, New York, N. Y., on November 30, 1944, and published here through the courtesy of that Society.

** Research department, Plastics Div., Monsanto Chemical Co.

[1] Numbers in parentheses refer to bibliography.

[2] Trade name, Monsanto Chemical Co.

TABLE I.—EFFECT OF FLORIDA AND MASSACHUSETTS EXPOSURE ON TENSILE PROPERTIES OF CELLULOSE ACETATE AND NITRATE SHEET PLASTICS[a]

Exposure time	*Modulus of elasticity*		*Yield stress*		*Tensile strength*		*Elongation*	
	Florida	*Mass.*	*Florida*	*Mass.*	*Florida*	*Mass.*	*Florida*	*Mass.*
months	*10^5 p.s.i.*	*10^5 p.s.i.*	*p.s.i.*	*p.s.i.*	*p.s.i.*	*p.s.i.*	*percent*	*percent*
CELLULOSE ACETATE SHEET PLASTIC								
Original	2.70 ± 0.03	2.70 ± 0.03	4970 ± 75	4970 ± 75	5540 ± 80	5540 ± 80	40 ± 5	40 ± 5
3	2.93 ± 0.02	2.80 ± 0.04	4650 ± 80	4800 ± 93	5175 ± 75	5310 ± 96	33 ± 5	35 ± 2
6	3.16 ± 0.04	2.96 ± 0.03	4360 ± 95	4520 ± 111	5080 ± 68	5130 ± 76	28 ± 4	30 ± 3
9	3.46 ± 0.04	3.11 ± 0.02	4120 ± 73	4340 ± 56	4960 ± 110	5030 ± 68	24 ± 3	27 ± 4
12	3.88 ± 0.05	3.41 ± 0.05	3990 ± 110	4300 ± 61	4890 ± 95	5010 ± 79	20 ± 3	24 ± 3
CELLULOSE NITRATE SHEET PLASTIC								
Original	2.04 ± 0.01	2.04 ± 0.01	5840 ± 64	5840 ± 64	6570 ± 115	6570 ± 115	38 ± 2	38 ± 2
1	2.17 ± 0.02	2.12 ± 0.03	4610 ± 87	5730 ± 80	6310 ± 65	6410 ± 63	14 ± 3	27 ± 3
2	2.39 ± 0.02	2.20 ± 0.01	3880 ± 79	5430 ± 71	4650 ± 96	6160 ± 81	3.1 ± 0.20	17 ± 2
3	2.44 ± 0.03	2.28 ± 0.01	....	5090 ± 76	936 ± 36	5800 ± 93	1.0 ± 0.07	9 ± 1
4	...	2.37 ± 0.02	....	4310 ± 57	430 ± 19	5000 ± 79	0 ± 1	4 ± 1
5	...	2.45 ± 0.03	....	....	260 ± 23	3270 ± 52	0 ± 1	1.0 ± 0.06
6	...	...	....	....	....	1520 − 33	...	...

[a] Specimens, 0.125 in. thick, were preconditioned 48 hr. at 50° C., stored in a desiccator, and tested at 0.2 in. per min. crosshead speed.

usually bleach and become lighter in color upon prolonged exposure, but cellulose nitrate formulations usually yellow and become darker.

4. Because of loss of plasticizer and degradation of the base plastic, shrinkage usually occurs upon prolonged exposure. This may also be accompanied by warping.

5. Fine surface cracks, known as crazing (21), and deeper cracks which penetrate nearly through the sheets form after extended exposure. These are the result of shrinkage and general deterioration of mechanical properties of the plastic. Crazing nearly always occurs first, because both shrinkage and degradation are most severe at the surface of the sheet. The deeper cracks usually occur only after prolonged exposure. Crazing is generally taken as the criterion of failure for materials whose use is optical in nature.

6. Stresses frozen in the plastic by the particular manufacturing process used, and other imperfections, are usually released upon extended exposure, thus impairing the surface quality of the object.

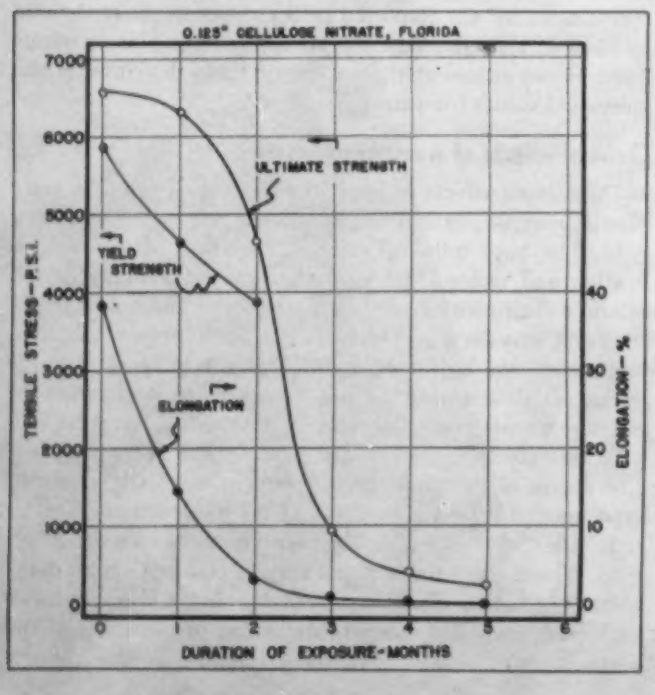
Tensile properties

Tensile properties were determined by the method specified in A.S.T.M. D 638–44 T (15); the method specified by Federal Specification L-P-406a (16) is identical. Stress-strain data were determined at a crosshead speed of 0.20 inch per minute.

Effect of sub-tropical exposure—The effect of exposure at Miami, Fla., on the ultimate tensile strength, yield stress and elongation is shown in Fig. 1 for the cellulose nitrate and in Fig. 2 for the cellulose acetate sheets. Fig. 3 shows the effect of Florida exposure on the modulus of elasticity of these two materials. Table I summarizes the effect of Florida exposure on the modulus of elasticity, yield stress, tensile strength and elongation at break of the cellulose acetate and nitrate sheet plastics.

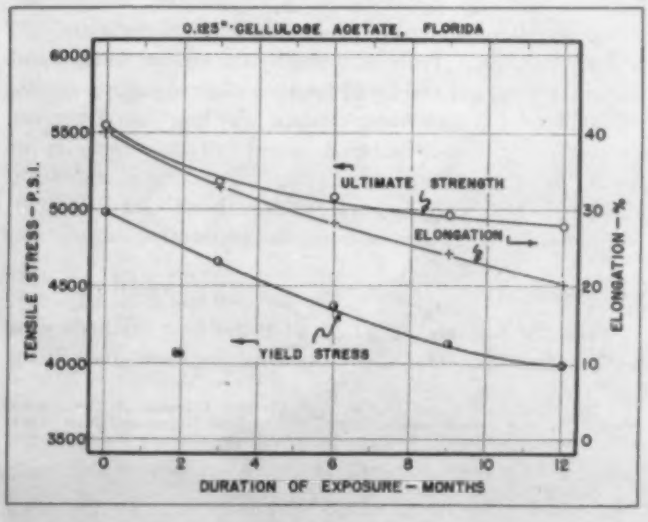
Effect of temperature exposure—The effect of exposure at Springfield, Mass., on the ultimate tensile strength, yield stress and elongation at break is shown in Fig. 4 for the cellulose acetate and in Fig. 5 for the cellulose nitrate sheets

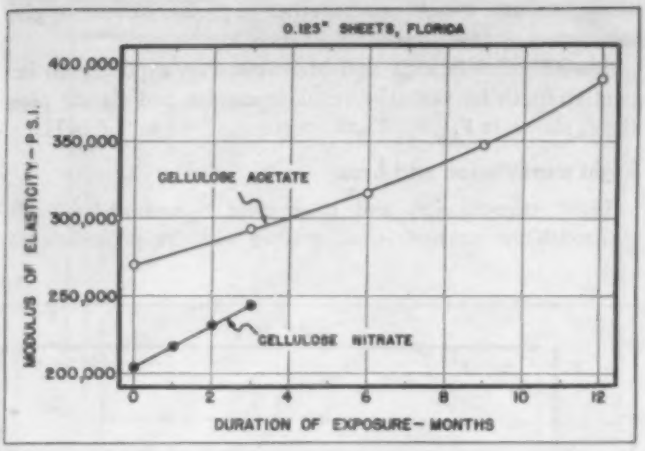
1



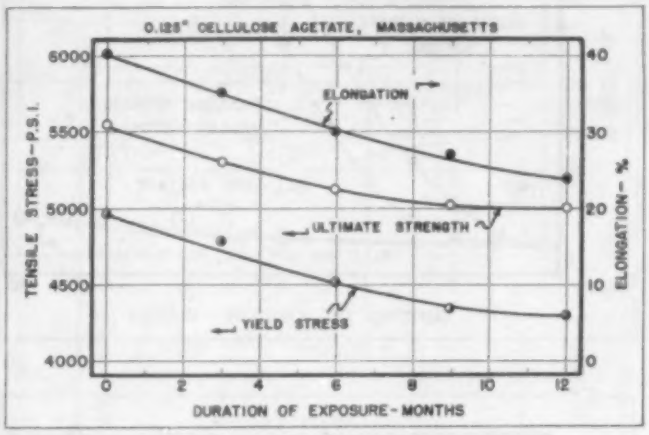
1—*Effect of exposure to weather at Miami, Fla., on tensile properties of cellulose nitrate sheet plastic.* **2**—*Effect on cellulose acetate sheet plastic of the same exposure as indicated in the chart on Fig. 1*

2

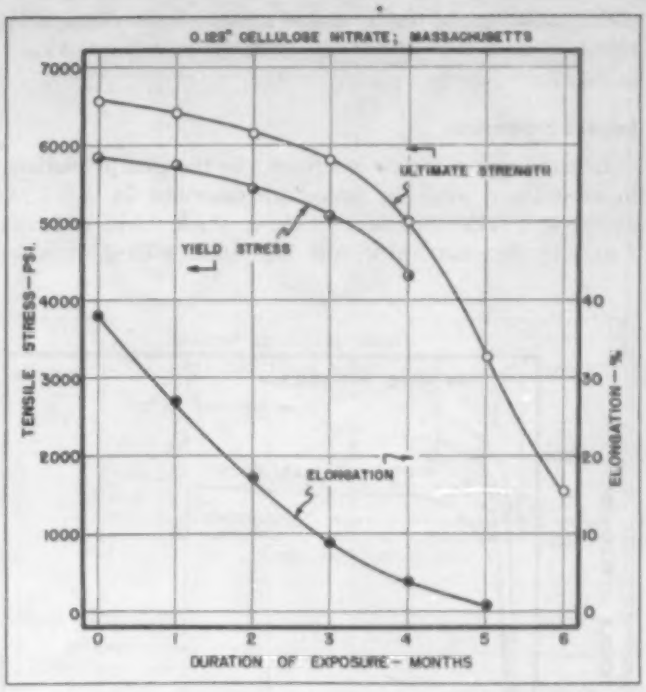




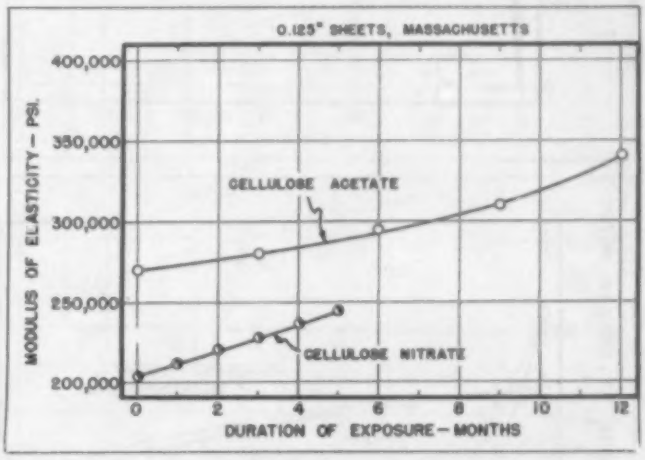
3



4



5



6

3—*Modulus of elasticity of cellulose acetate and nitrate sheet plastics as effected by exposure to Miami, Fla., weather.* **4, 5**—*Effect of weather exposure at Springfield, Mass., on tensile properties of cellulose acetate and nitrate sheet, respectively.* **6**—*Weather exposure effects on modulus of elasticity of cellulose acetate and nitrate sheet plastics at Springfield, Mass.*

Figure 6 shows the effect of such exposure on the modulus of elasticity of these two materials. Table I summarizes the effect of Springfield exposure on the modulus of elasticity, yield stress, tensile strength and elongation at break of the cellulose acetate and nitrate sheet plastics.

Effect of various accelerated aging environments—Cellulose nitrate plastic 0.010 in. thick was subjected to various accelerated aging tests; namely, 1) 48 hr. under an S-1 sunlamp at a distance of 6 in., 2) 14 days in a circulating-air oven at 50° C. and 3) two months' outdoor exposure at Springfield. At the end of the designated exposure time, stress-strain data were determined. These tests were run on a Scott IP-4,

TABLE II.—EFFECT OF FLORIDA AND MASS. EXPOSURE ON IMPACT STRENGTH OF CELLULOSE ACETATE AND NITRATE SHEET[a]

Exposure Time	*Florida, impact strength*	*Mass., impact strength*
months	*ft.-lb./in. of notch*	*ft.-lb./in. of notch*
	CELLULOSE ACETATE SHEET PLASTIC	
Original	3.28 ± 0.09	3.28 ± 0.09
3	3.04 ± 0.11	3.14 ± 0.13
6	2.81 ± 0.17	2.93 ± 0.24
9	2.51 ± 0.09	2.67 ± 0.17
12	2.01 ± 0.19	2.20 ± 0.18
	CELLULOSE NITRATE SHEET PLASTIC	
Original	4.13 ± 0.08	4.13 ± 0.08
1	2.56 ± 0.13	3.07 ± 0.12
2	1.21 ± 0.14	2.09 ± 0.11
3	0.33 ± 0.02	1.32 ± 0.09
4	...	0.62 ± 0.07
5	...	0.15 ± 0.01

[a] Specimens made up of four 0.125-in.-thick pieces were preconditioned 48 hr. at 50° C., stored in a desiccator, and tested edgewise.

TABLE III.—EFFECT OF FLORIDA AND MASSACHUSETTS EXPOSURE ON THE LIGHT TRANSMISSION AND HAZE OF CELLULOSE ACETATE AND NITRATE SHEET PLASTICS

Exposure time	*Light transmission*		*Haze*	
	Florida	*Mass.*	*Florida*	*Mass.*
months	*percent*	*percent*	*percent*	*percent*
	CELLULOSE ACETATE SHEET PLASTIC			
Original	89.9	89.9	3.1	3.1
3	90.1	90.2	3.6	3.4
6	90.3	90.9	5.0	4.6
9	90.9	91.4	7.3	6.4
12	91.2	92.1	9.8	8.7
	CELLULOSE NITRATE SHEET PLASTIC			
Original	90.1	90.1	2.5	2.5
1	83.8	85.1	4.5	3.0
2	76.3	80.1	11.9	4.3
3	71.0	74.7	22.0	8.9
4	66.9	70.8	35.1	17.2
5	63.0	67.1	53.1	30.8
6	60.0	63.5	66.6	49.5

tilting-table tensile tester at 600 r.p.m. Stress-strain relationships after the various exposures are shown graphically in Fig. 7.

Impact properties

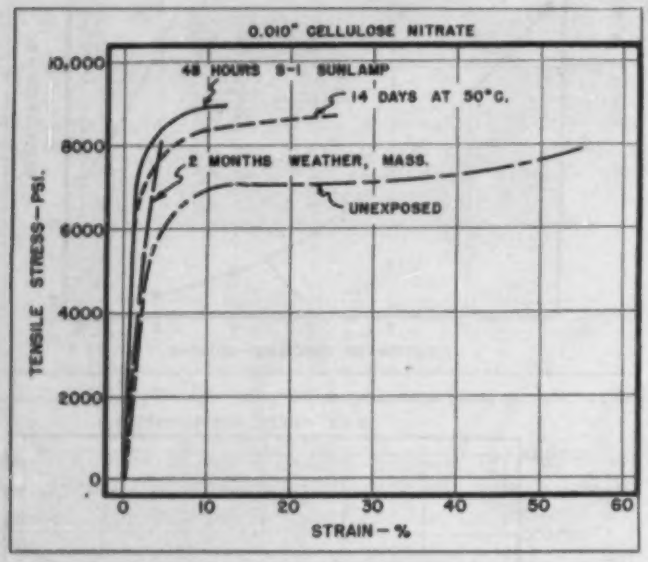
Impact properties were determined by the Charpy method, in accordance with the procedure described in A.S.T.M. D 256–43 T (17). Specimens 0.125 in. thick, 0.5 in. wide and 5 in. long were notched with a single-tooth milling cutter at 400 r.p.m. and wire-bound together in groups of four to give the correct aggregate width (0.5 inch).

The effect of Florida and Massachusetts exposure on impact strength for both the cellulose acetate and nitrate plastics is shown in Fig. 8. Data are summarized in Table II.

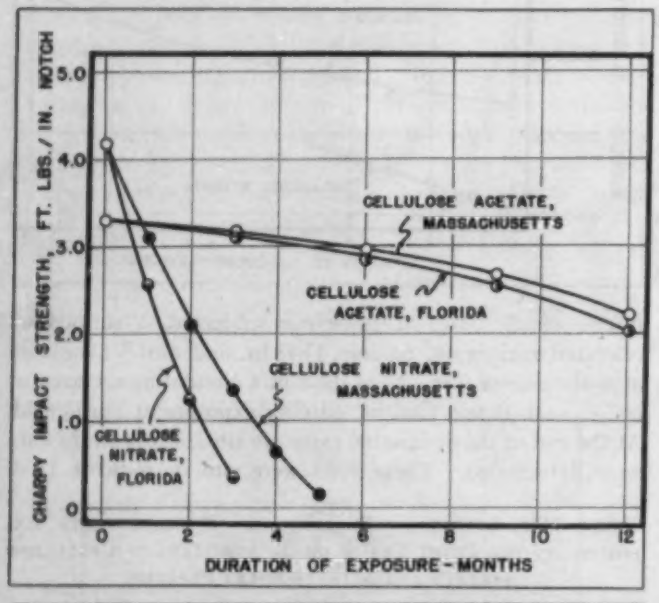
Light transmission and haze

Light transmission and haze were determined by the Axilrod-Kline method, in accordance with the procedure de-

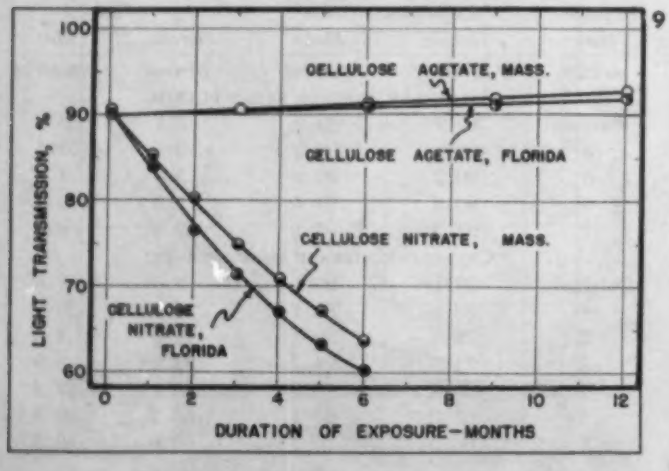
7



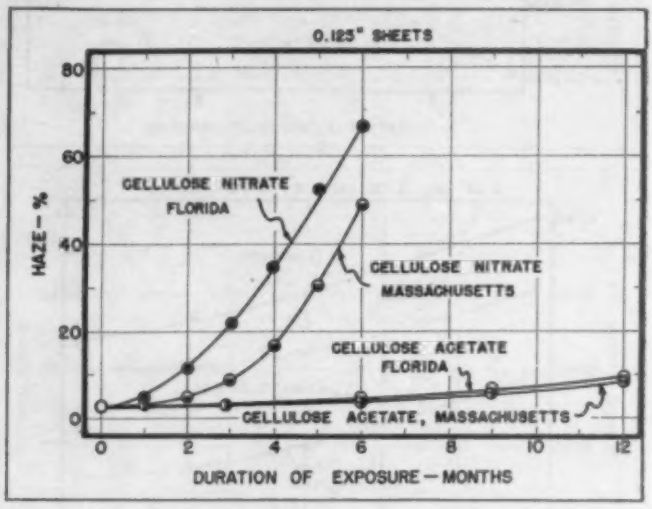
8



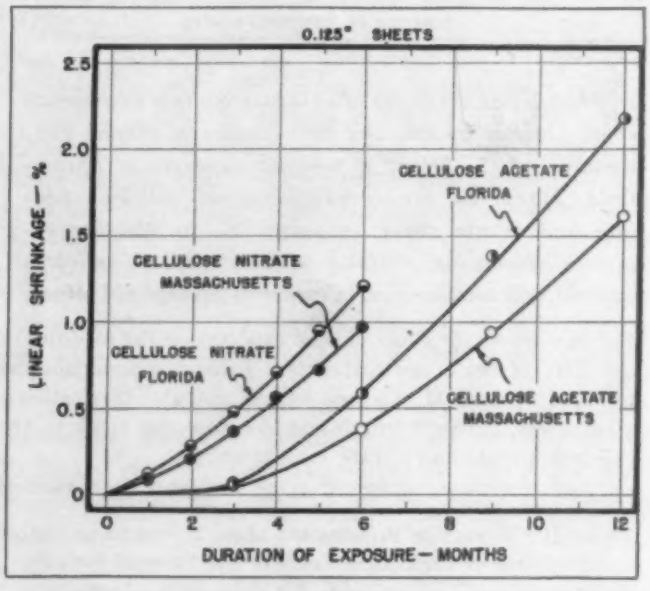
9



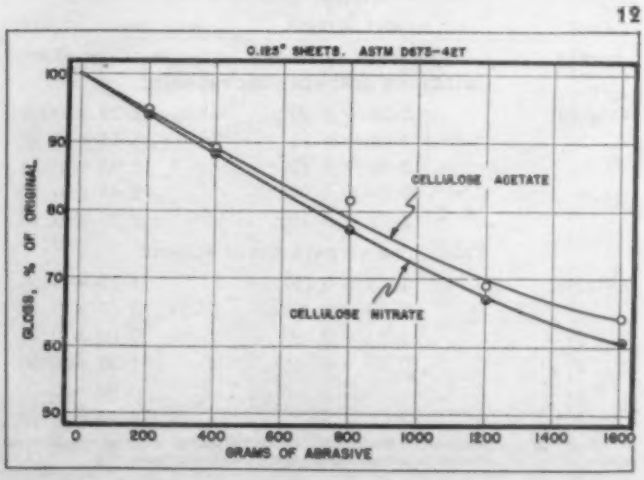
10

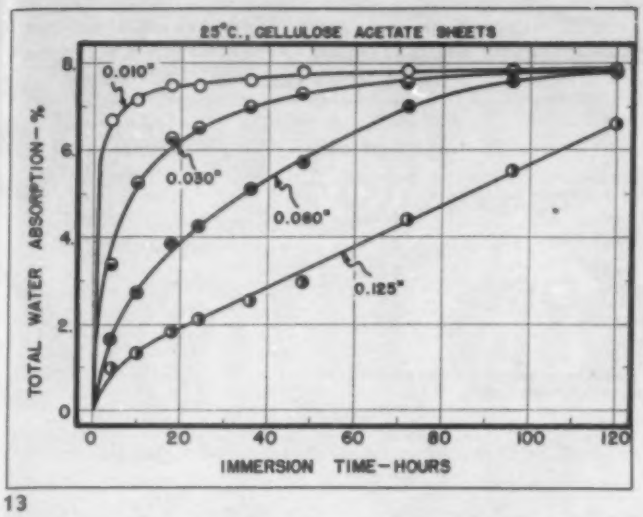


11

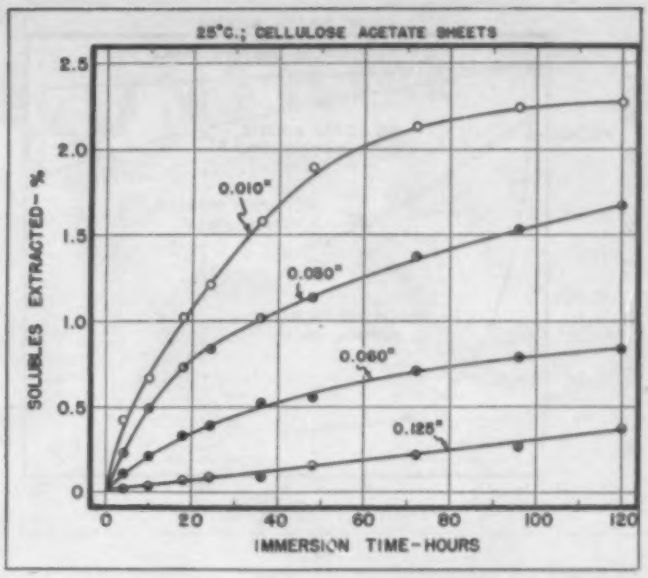


12

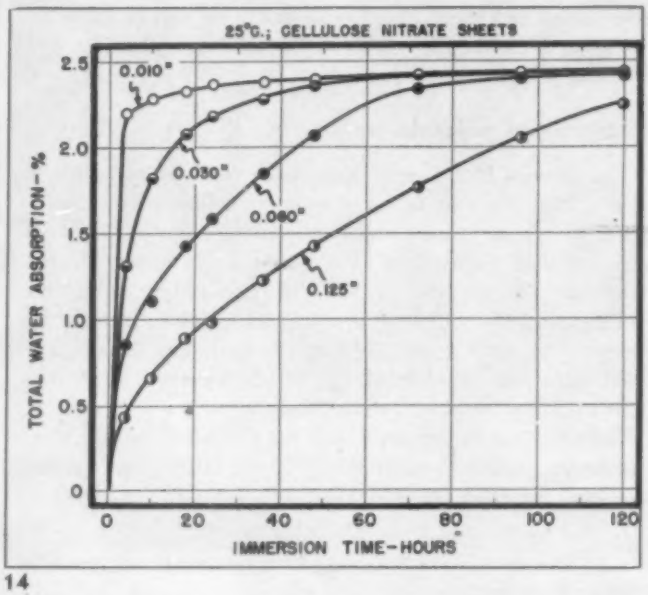




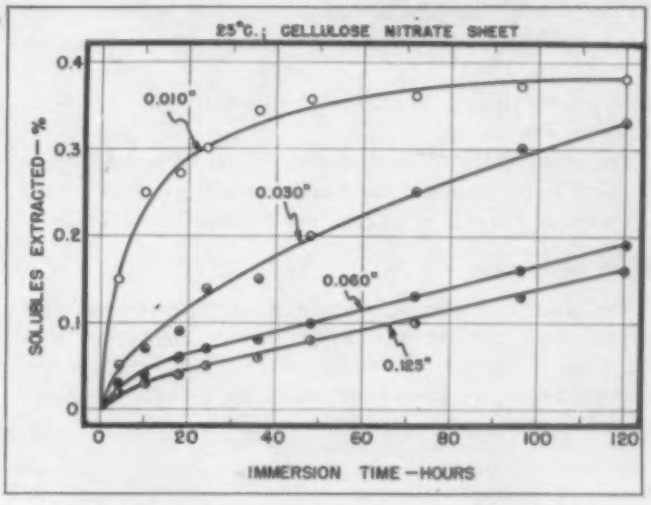
13



15



14



16

7—Heat, light and weather exposure effects on stress-strain properties of cellulose nitrate sheet at Springfield, Mass. **8** *to* **11**—*Effect of weather exposure at Springfield, Mass., and Miami, Fla., on such properties of cellulose acetate and nitrate sheet as: 8) impact strength; 9) light transmission; 10) haze; 11) linear shrinkage.* **12**—*Abrasion resistance of cellulose acetate and nitrate sheet;* **13** *and* **14**—*Water absorption of cellulose acetate and nitrate sheet, respectively.* **15** *and* **16**—*Soluble matter extracted from cellulose acetate (15) and nitrate (16) sheet on immersion in water*

scribed in A.S.T.M. D 672–42 T (18). Specimens 0.125 in. thick and 3 in. square were used.

The effect of Florida and Massachusetts exposure on the light transmission and haze of both cellulose acetate and cellulose nitrate plastics is shown in Figs. 9 and 10, respectively. The data are summarized in Table III.

TABLE IV.—EFFECT OF FLORIDA AND MASSACHUSETTS EXPOSURE ON THE SHRINKAGE OF CELLULOSE ACETATE AND NITRATE SHEET PLASTICS

Exposure time	*Florida, shrinkage*	*Mass., shrinkage*
months	*percent*	*percent*
	CELLULOSE ACETATE SHEET PLASTIC	
3	0.03	0.01
6	0.58	0.33
9	1.42	0.96
12	2.18	1.62
	CELLULOSE NITRATE SHEET PLASTIC	
1	0.12	0.09
2	0.28	0.22
3	0.48	0.37
4	0.71	0.56
5	0.96	0.76
6	1.21	0.98

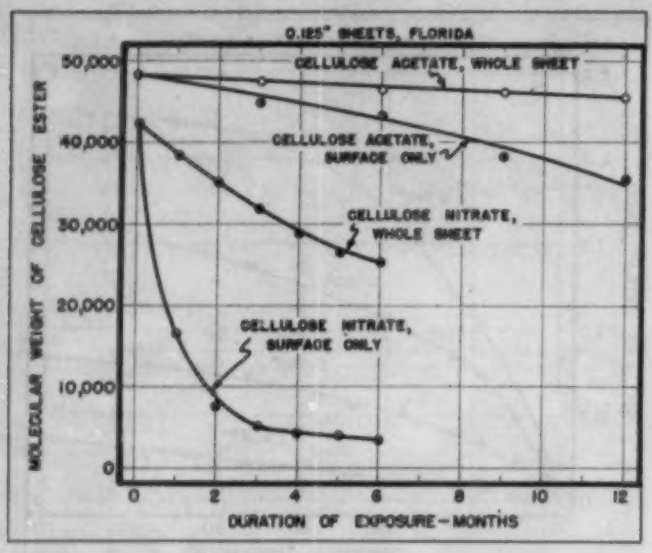
Shrinkage

Shrinkage was determined by scribing marks 10 in. apart in both directions of the 12- by 12-in. plastic sheets. The distance between marks was measured to within 0.01 in. before and after exposure. The shrinkage reported was calculated by dividing the difference in length between marks before and after exposure by the original length. The values reported are the average of the two directions.

The effect of Florida and Massachusetts exposure on the shrinkage of both cellulose acetate and nitrate plastic sheets is shown in Fig. 11. Data are summarized in Table IV.

Abrasion resistance

The abrasion resistance of cellulose acetate and cellulose nitrate sheet plastics was determined by the Boor Abrader, in accordance with A.S.T.M. D 673–42 T (19). Specimens 0.125 in. thick and 2 in. square were used. The specimens



17—*Effect of exposure to weather at Miami, Fla., on the molecular weight of base cellulose ester in cellulose acetate and cellulose nitrate sheet plastics*

were preconditioned 48 hr. at 50° C. and stored in a desiccator prior to testing.

The effect of the amount of abrasive on the original gloss for both cellulose acetate and cellulose nitrate sheet plastic is shown in Fig. 12. The data are summarized in Table V.

Water absorption

The water absorption for cellulose acetate and cellulose nitrate sheet plastics was determined in accordance with A.S.T.M. D 570–42 (20). In addition, long-time water-absorption tests were run to determine the time for the plastic to reach equilibrium.

TABLE V.—EFFECT OF THE AMOUNT OF ABRASIVE ON THE ORIGINAL GLOSS FOR CELLULOSE ACETATE AND CELLULOSE NITRATE SHEET PLASTICS[a]

Abrasive	*Cellulose acetate, change in original gloss*	*Cellulose nitrate, change in original gloss*
grams	*percent*	*percent*
200	94.8	94.1
400	89.0	88.4
800	81.4	77.3
1200	69.0	67.1
1600	64.3	60.8

[a] Specimens were preconditioned 48 hr. at 50° C., stored in a desiccator, and tested with a Boor Abrader.

The effect of immersion time on the total water absorption is shown graphically in Fig. 13 for cellulose acetate and in Fig. 14 for cellulose nitrate plastic. The effect of immersion time on solubles lost is shown graphically in Fig. 15 for cellulose acetate and in Fig. 16 for cellulose nitrate plastic. The data are summarized in Table VI.

Viscosity and molecular weight

The effect of Florida exposure on the viscosity and molecular weight of the base cellulose esters in cellulose acetate and cellulose nitrate sheet plastic was determined. Viscosity measurements were made at 25° ± 0.02° C. using Fenske pipettes. The exposed plastic was dissolved in anhydrous acetone, and the cellulose acetate and cellulose nitrate was precipitated with a non-solvent, washed and dried. The dried ester was dissolved in anhydrous acetone; concentrations to give η_r = 1.2–1.3 were chosen.

Viscosity was determined both on the whole plastic sheet and on the surface portion only. In the latter case, the surface was scraped off and then (*Please turn to page 176*)

TABLE VI.—EFFECT OF IMMERSION TIME AND THICKNESS ON THE TOTAL WATER ABSORPTION AND SOLUBLES LOST OF CELLULOSE ACETATE AND CELLULOSE NITRATE SHEET PLASTICS

Immersion time	*Thickness: 0.010 in.*		*Thickness: 0.030 in.*		*Thickness: 0.060 in.*		*Thickness: 0.125 in.*	
	Cellulose acetate	*Cellulose nitrate*	*Cellulose acetate*	*Cellulose nitrate*	*Cellulose acetate*	*Cellulose nitrate*	*Cellulose acetate*	*Cellulose nitrate*
hr.	*percent*	*percent*	*percent*	*percent*	*percent*	*percent*	*percent*	*percent*
				TOTAL WATER ABSORPTION				
4	6.69	2.22	3.36	1.31	1.61	0.85	1.04	0.43
10	7.18	2.29	5.27	1.83	2.73	1.10	1.32	0.65
18	7.50	2.32	6.28	2.08	3.86	1.43	1.83	0.89
24	7.43	2.36	6.52	2.19	4.25	1.59	2.08	0.98
36	7.60	2.38	7.01	2.28	5.13	1.85	2.53	1.23
48	7.80	2.40	7.32	2.37	5.74	2.07	2.99	1.43
72	7.81	2.43	7.57	2.40	7.00	2.36	4.41	1.77
96	7.85	2.43	7.83	2.43	7.69	2.41	5.58	2.05
120	7.87	2.44	7.85	2.43	7.85	2.43	6.85	2.25
				SOLUBLES LOST				
4	0.43	0.15	0.24	0.05	0.11	0.04	0.02	0.02
10	0.67	0.25	0.50	0.07	0.21	0.05	0.04	0.03
18	1.02	0.27	0.74	0.08	0.33	0.06	0.07	0.04
24	1.21	0.30	0.83	0.14	0.38	0.07	0.09	0.05
36	1.58	0.35	1.01	0.15	0.51	0.08	0.09	0.06
48	1.91	0.36	1.13	0.20	0.53	0.09	0.16	0.08
72	2.14	0.36	1.36	0.25	0.69	0.13	0.22	0.10
96	2.24	0.37	1.54	0.30	0.77	0.16	0.26	0.13
120	2.26	0.38	1.68	0.33	0.82	0.19	0.38	0.16

TECHNICAL BRIEFS

Abstracts of articles on plastics in the world's scientific and engineering literature relating to properties and testing methods, or indicating significant trends and developments.

Engineering

INFLUENCE OF THE MILLING PROCESS ON THE PROPERTIES OF HIGHLY POLYMERIZED SUBSTANCES (CELLULOSE AND POLYSTYRENE) II. K. Hess, E. Steurer and H. Fromm. Kolloid Z. *98*, 290-304 (Mar. 1942). A theoretical consideration of the impact energy and compressive stresses in a ball mill reveals that the impact energies are sufficient to overcome the atomic forces in molecules, but that the compressive stresses are not sufficient to overcome atomic forces. Compressive stresses are of sufficient magnitude to overcome van der Waals forces. Experimental results show that the impact energy of the balls is transformed directly into the molecular oscillation energy of the particles of the substance being milled.

PLASTIC CRAZING AVOIDED. Aviation *43*, 205 (Oct. 1944). Materials which contain ester-type plasticizers and which come in contact with acrylic plastic cause crazing of the plastic, particularly when the plastic is under stress.

HOT FORMING OF PHENOLIC LAMINATES. H. C. Guhl. Plastics and Resins Ind. *3*, 7–11 (Aug. 1944). The properties of N.E.M.A. grade C phenolic laminate and two grades of hot-formable phenolic laminates are compared. Information concerning procedures and equipment for hot forming is given.

PROTECTION OF RADIO COMPONENTS FOR THE TROPICS. W. J. Tucker. Plastics (London) *8*, 477–80 (Oct. 1944). Radio transformers, chokes and coils are coated with plastic to protect them against climatic exposure in the tropics. Varnishes based on natural drying oils and resins and on synthetic resins are used; the synthetic type are preferred. The parts are dip-coated and the resin cured by baking.

STRENGTH OF NEW PLASTICS. J. Delmonte. Machine Design *16*, 119–22 (Aug. 1944). The latest commercial developments in the unsaturated cross-linked ester type resins are reviewed. Most of the resins on the market are used in the manufacture of laminates, although two are used in transparent form. The resins are cured by organic peroxide catalysts such as benzoyl or lauryl peroxide. Cotton and glass fabrics are used for the laminates. The curing conditions range from temperatures of 240 to 300°F. for a few to 60 min. at contact pressures. The best results are obtained if the resins are kept out of contact with air while they are being cured. The resin contents of the laminates vary from 40 to 65 percent. The strength of these laminates is high. The cured resins are thermosetting, which makes it possible for transparent enclosures made of these resins to withstand higher temperatures more successfully than the transparent thermoplastic materials. These resins are being used to make aircraft parts, heat-resistant transparent enclosures, water breakers and arctic first-aid kit enclosures.

PULP PREFORM. H. C. Martin. Plastics (London) *8*, 520–9 (Nov. 1944). Cellulose fibers are cooked with caustic soda, seasoned and washed. The cooked pulp in water is beaten in a paper beater. A phenolic resin emulsion is added after beating for a few hours and after further beating for a short period sodium aluminate is added. This precipitates the resin on the pulp. The pH is finally adjusted to 4.6 to 5.0 with aluminum sulfate. The slurry of pulp and resin is passed over gauze forms and suction applied to make the preform on the wire form. The preform is removed, dried and molded in steel dies.

Chemistry

POLYMERIZATION. G. S. Whitby. Chem. Eng. News *22*, 1570–5 (Sept. 25, 1944). The various types of polymerization and the properties of high polymers are discussed in a broad, general way.

COPOLYMERIZATION OF STYRENE AND METHYL METHACRYLATE. F. R. Mayo and F. M. Lewis. J. Am. Chem. Soc. *66*, 1594–1601 (Sept. 1944). On the basis that the copolymerization of any two monomers involves the reactions of the two kinds of monomer molecules with the two kinds of active centers derived therefrom, it was found that the composition of a copolymer can be expressed as a function of the initial monomer concentrations, of the conversion, and of two constants which are characteristic of each monomer pair. In free-radical type polymerizations, each constant (called a monomer reactivity ratio) refers to one of the two radical types; it is the ratio of the rate constants for the reaction of the chosen radical with the monomer from which it was derived and with the other monomer, respectively. A study of the copolymerization of styrene and methyl methacrylate by a free radical mechanism at 60° C. indicates that the monomer reactivity ratios are independent (within experimental error) of the composition of the monomer mixture, the extent and rate of conversion, small quantities of certain added materials, moderate proportions of benzene and ethyl acetates as solvents, and the presence or absence of benzoyl peroxide as catalyst. In this system, the styrene-type radical has a marked preference for reacting with ester; the ester-type radical prefers to react with styrene. The equation developed permits calculation of the products of copolymerization and accurate comparison of the rates of reaction of a series of monomer molecules with a chosen radical.

EQUILIBRIUM DISTRIBUTION IN SIZES FOR LINEAR POLYMER MOLECULES. A. V. Tobolsky. J. Chem. Phys. *12*, 402–4 (Oct. 1944). Systems of linear polymer molecules are characterized by favorable heats of polymerization counter-balanced by unfavorable entropies of polymerization. Long chains are therefore formed and are stable at low temperatures while at sufficiently high temperature appreciable amounts of monomeric units split off. At any given temperature there exists a definite equilibrium distribution in sizes. This distribution is derived by statistical methods and proves to be a very simple function of the heat of polymerization.

ESTERIFICATION OF CELLULOSE BY ACIDS AND ACID ANHYDRIDES AS VAPORS. G. Champetier and M. Foex. Bull. soc. chim. *9*, 711–13 (1942); Chem. Abstracts *38*, 3125 (June 20, 1944). The degree of nitration of cellulose by nitric acid vapor decreases rapidly as the acid content of the gases is decreased; there is no nitration if the nitric acid content of the vapor is less than 66 percent. A low degree of esterification is obtained with formic and acetic acid vapors; the degree is comparable with that obtained in the liquid phase without dehydrating agents. Acetic anhydride vapor reacts better than acetic acid vapor. The acetyl content reaches 16.6 percent in 200 hr. at 150°C.

SYNERGY IN INDUSTRIAL CHEMISTRY. P. Macaluso. Ind. Eng. Chem. *36*, 1071–4 (Nov. 1944). Synergy, or nonadditive nonideal behavior in mixtures and polycomponent systems, is com-

mon in all branches of chemistry. Solvents, catalysts, emulsions, surface-active agents and plastics offer many examples of its practical utilization. Synergic mechanisms can be classified generally as involving stepwise action, direct interaction or complementary functioning of the components. Self-association, packing effects, dissymmetry and interaction of components appear to be among the factors underlying all truly synergic phenomena as distinguished from combined, stepwise processes which are only apparently synergic. The extent of synergy is not easily determined quantitatively in most systems, and erroneous assumptions regarding ideal behavior have led to some confusion. Valid measures depend on the use of significant and additive quantities. Awareness of the possibilities of synergy can greatly aid the work of the research chemist having at his disposal many gradations of chain length, polarity and particle size. The possibility of synergy should also be considered in the drawing up of patents involving polyfunctional reactants, classes of materials and multistepped processes.

Properties

THE MECHANICAL PROPERTIES OF TRANSPARENT SYNTHETIC MATERIALS. W. Küch. Luftfahrt-Forsch. *19*, 111–20 (1942); Chem. Abstracts *38*, 3385 (July 10, 1944). Transparent plastic sheets for aircraft enclosures are discussed. Acrylic ester and styrene resins are brittle. Polyvinyl chloride and cellulose acetate are tough. The maximum load supported in a 30-day creep test is 55 to 75 percent of the tensile strength.

GENERAL PROPERTIES OF INJECTION MOLDED PLASTICS. Aviation *43*, 203, 205 (Aug. 1944). General properties of injection molded plastics are reported in tabular form. The materials included are ethyl cellulose, cellulose acetate, cellulose acetate butyrate, rigid vinyl chloride acetate, flexible vinyl chloride acetate, vinyl chloride, vinylidene chloride, acrylate, styrene, urea-formaldehyde and phenol-formaldehyde plastics.

RELATIONSHIP BETWEEN STRUCTURE AND MECHANICAL PROPERTIES OF MOLDED PHENOPLASTICS. W. Siegfried. Schweiz. Arch. angew. Wiss. Tech. *8*, 255–62 (1942); Chem. Abstracts *38*, 3746 (July 20, 1944). The results of shear tests made on phenolic, urea and melamine resin compositions containing various fillers are reported.

THE OPTICAL ANISOTROPY OF CELLULOSE FILM. R. C. Gray. J. Soc. Chem. Ind. *63*, 241–5 (Aug. 1944). The birefringence of cellulose film is found to be influenced by the pressure in the viscose at the moment of extrusion, by the rate of coagulation, and by the machine direction forces and the transverse frictional forces exerted on the film during the casting process; the relative retardation is unaffected by change of water content, but since increase of water content causes increase of thickness, it causes a corresponding reduction in birefringence. The birefringence has a minimum value B_0 at the middle of the web, and rises toward the selvedges in accordance with the law $B = B_0 + bx^4$, where x is the distance from the middle of the web, and b is a positive constant that depends on the transverse forces acting on the film during contraction. The dispersion of the birefringence follows the law $B = a + b/\lambda^2 + c/\lambda^4$, where a, b and c are positive constants and λ is the wave length; B has a minimum value in the extreme red. For the same grade of film, the tensile strength in the machine direction, or in the transverse direction, is greater when the birefringence is greater. Stress in the machine direction can increase the permanent birefringence by 50 percent. Stress in the transverse direction can reduce the permanent birefringence to zero, and can reverse its sign; the final birefringence may be numerically as great as the initial birefringence. All commercial dyed cellulose films are dichroic, the effect being most pronounced in the chocolates and mauves.

COMPREG AS A LAMINATED WOOD AND AS A PLASTIC. J. F. Dreyer. Mechanical Eng. *66*, 710–12 (Nov. 1944). Compreg is made commercially by impregnating rotary-cut maple veneers with a phenolic resin solution, drying, and bonding the veneers under heat and pressure until the resin is cured. The properties of the product are as follows: specific gravity, 1.31 to 1.37; Izod impact strength, 7.0 ft.-lb./in. of notch; modulus of rupture, 35,000 p.s.i.; modulus of elasticity, 3,000,000 p.s.i.; tensile strength, 30,000 p.s.i.; coefficient of thermal expansion, 5.9×10^{-6}/°C. parallel to the grain and 68.7×10^{-6}/°C. perpendicular with the grain. The parallel-grain product is recommended for maximum mechanical efficiency. Variations in properties may be obtained by varying the type of wood used.

Testing

MOLECULAR WEIGHT OF HIGH-MOLECULAR SUBSTANCES BY THE METHOD OF LONGITUDINAL SCATTERING OF INFRARED RAYS. W. W. Lepeschkin. Kolloid-Z. *105*, 141–4 (1943); Chem. Abstracts *38*, 4852 (Sept. 20, 1944). An improved apparatus for obtaining and measuring longitudinal scattering of infrared rays is described.

SYSTEMATIC PROCEDURE FOR IDENTIFICATION OF SYNTHETIC RESINS AND PLASTICS. T. P. G. Shaw. Ind. Eng. Chem. Anal. Ed. *16*, 541–49 (Sept. 1944). A procedure is given for identifying most of the resins of commercial importance. The resin is first isolated from solvents, plasticizers, fillers, pigments, dyes and other resins. Next, the resin is classified into one of eight groups. The resin is then identified according to procedures given for each group. Finally confirmation is made by specific tests.

MICROSCOPIC EXAMINATION OF REINFORCED SYNTHETIC RESINS. C. M. Gordon. J. Soc. Chem. Ind. *63*, 272–7 (Sept. 1944). A technique is described for preparing microscopic sections of plastics and for differentially staining the various kinds of resin and fibers intended for use as structural materials. Translucent sections were prepared by using the petrologists' method of grinding and polishing. Most plastics can be taken down to 15 - 20μ, but in transverse sections, poorly impregnated paper laminates tend to delaminate when the thickness is less than 30μ. The reagents which have been found to give color reactions are: 1) sulfuric acid, 2) ammonia and bromine, 3) neutral red chloride, 4) *p*-phenylenediamine, 5) methyl red, 6) Dispersal Fast Red L. G. G., and 7) Kiton Blue V. The plastics investigated include alkyds, ureas, polystyrene, polyvinyl formal, acrylates, and various types and grades of phenolics. The fibers include kraft paper, cotton fabric, straw and cellulose acetate fabric. Most of the article deals with fiber-filled phenolics. There is evidence that phenolic resins can penetrate the cellulose fiber wall and, on condensing there, form a combination, possibly of the lignin-cellulose type, which alters the staining and optical properties of the fiber. This does not occur at precure, but subsequently in the press, owing to the temperature and not the pressure. It is much modified by the different kinds of fibers, and slightly by the kind of resin. The strength of the resin-fiber bond increases with this modification of the fiber, and influences the way in which the board fails and its property of pseudo-ductility. During the manufacture of an ordinary board, the fiber has acquired a slight affinity for acid dyes and a remarkable one for methyl red and *p*-phenylenediamine which can only be due to the entrance of the resin, or some part of it, into the fiber wall; this resin is not, however, homogeneous with the resin outside the fiber and in the lumen. In the boards the staining of the main body of the resin stops abruptly at the edge of the fiber, the only exception being the acetylated cotton fabric in which the transverse sections show that the

fibers on the outside of the yarn stain faintly with bromine and very markedly with neutral red; this probably means that the resin outside and inside the fiber wall is in a continuous phase in the same physical condition, because the cotton by itself does not stain. The staining reactions of the fibers are very much altered by the various resins, although there may not be any evidence for the resin having entered the fiber wall. Kiton Blue will stain a cotton fiber embedded in phenolic resin, but will not touch the same fibers when they are in urea resin. In the uncured state the resin is inert, possibly owing to saturation of its acid staining groups by the hydroxyl ends of the cellulose, since when they are acetylated the resin shows itself readily, staining with aqueous methyl red and *p*-phenylenediamine. On curing something happens which radically alters the impregnated fiber, and this process increases in intensity in any subsequent heating. If this is not a chemical combination between the resin and cellulose, it is a very close association which is vitiated by the acetylation of the cellulose, and has special staining reactions of its own. There is no clear correlation between the mechanical properties of board, the way it has been made, or mismade, and its microscopic appearance. This is partly because the staining reactions are more sensitive to such things as small changes in pH (which may be irrelevant to the mechanical quality of the board) than to whatever factors influence impact strength, ductility, and so forth; also there are the statistical changes (such as orientation of the fibers in the machine direction of the paper) which become less apparent as the magnification increases, but become very noticeable in the sum of their effect on the tensile strength. It is unlikely that plastic microscopy could become more than a qualitative adjunct to mechanical testing.

A SIMPLE, RAPID METHOD FOR THE DETERMINATION OF THE MAXIMUM WATER ABSORPTION BY SUBSTANCES. F. H. Müller. Kolloid-Z. *105*, 16–20 (1943). A method is described for determining the water absorption of materials in less than one hour. The accuracy is estimated to be 10 to 15 percent. Typical results are: polystyrene 0.15 to 0.20 percent, a vinyl resin 0.3 to 0.4 percent, cellulose triacetate 6 to 10 percent. This method is not applicable to substances in which hysteresis effects occur or in which equilibrium is established very slowly.

Synthetic rubber

TIME-TEMPERATURE RELATIONS IN OVEN AGING OF GR-S. S. R. Harrison and O. D. Cole. Ind. Eng. Chem. *36*, 702–7 (Aug. 1944). Results of laboratory stress-strain and dynamic cut-growth tests show that, in all case observed, the time-temperature relations for a definite change in properties follows a general form: $\log t = kT + C$ where t = time of aging and k and C are constants. The temperature coefficients for changes in stress-strain properties brought about by oven aging were: 1.972 (200 percent), 2.00 (300 percent), 1.945 (tensile strength) and 1.957 (elongation at break) for every 10°C. rise in temperature. These figures are close to 2.0, the value observed for most chemical reactions. The temperature coefficient for change in rate of cut growth was 1.715 for every 10°C. This lower value is attributed to the effect of hysteresis and/or relaxation during the test. After aging, the properties of overcured samples were superior to optimum cured samples.

SYNTHETIC RUBBER FOR PRESENT AND POSTWAR PRODUCTS. Product Eng. *15*, 680–96 (Oct. 1944). This is a special section dealing with the compounding, properties and applications of Buna S, neoprene, butyl, Buna N, and Thiokol synthetic rubbers.

ELECTRON MICROSCOPE STUDIES OF COLLOIDAL CARBON IN VULCANIZED RUBBER. W. A. Ladd. Ind. Eng. Chem. Anal. Ed. *16*, 642–4 (Oct. 1944). New techniques are described for electron microscopy studies of colloidal carbon in vulcanized natural and synthetic rubber. The rub-out technique, because of its directional effect, is poorest of the three methods. The vulcanizing method is the most successful of the three, and gives the best pictures. Some distortion may be present due to the high pressures used. The replica method involves no distortion of the rubber block. Its disadvantage lies in difficulty of interpretation of the pictures and poor definition in the case of replicas of the fine carbons.

EFFECT OF DEFORMATION ON THE SWELLING CAPACITY OF RUBBER. P. J. Flory and J. Rehner, Jr. J. Chem. Phys. *12*, 412–14 (Oct. 1944). Elongation of swollen vulcanized rubber, or other polymeric materials possessing random network structures, should increase the amount of liquid absorbed (dissolved) at equilibrium with an excess of the swelling agent. According to a previously published equation relating to the thermodynamics of stretching and swelling of rubber, the relative volume of the swollen rubber at equilibrium should equal the square root of the relative stretched length. Experiments with butyl rubber vulcanizates in xylene support these predictions of theory.

AGING OF GR-S VULCANIZATES IN AIR, OXYGEN, AND NITROGEN. J. R. Shelton and H. Winn. Ind. Eng. Chem. *36*, 728–30 (Aug. 1944). The results of aging GR-S type vulcanizates in air, oxygen and nitrogen show that: 1) the decrease in tensile strength observed in both bomb and oven aging is caused by the action of oxygen; 2) the modulus increase obtained in the oxygen bomb at 80°C. is not caused by oxygen; and 3) at 100°C. in air, more than half of the hardening, as measured by the modulus increase obtained after 5 days, may be attributed to the action of oxygen. It appears that oxygen acts upon GR-S vulcanizates in two distinctly different ways: 1) A reaction leading to tensile breakdown which involves chain scission. This reaction takes place at both 80 and 100°C., and is effectively retarded by the antioxidant, phenyl-β-napthylamine. 2) A reaction producing a stiffening of the GR-S as shown by the modulus increase. This stiffening suggests the formation of polymeric products — for example, by cross linkage. This reaction was not observed at 80°C. but was a major factor in the aging at 100° and was little affected by the antioxidant employed.

THE TECHNICAL PROPERTIES OF DIFFERENT KINDS OF SOFT RUBBER WHICH ARE IMPORTANT IN CABLE PRODUCTION. H. Roelig. Electrotech. Z. *63*, 465–6 (1942); Chem. Abstracts *38*, 4829–30 (Sept. 10, 1944). The relations between the temperature and the mechanical and electrical properties of soft rubber used for cable insulation are reported. High water absorption has a more detrimental effect on filled vulcanizates than on unfilled vulcanizates.

PLANT INVESTMENT AND PRODUCTION COSTS FOR SYNTHETIC RUBBER. E. R. Gilliland and H. M. Lavender, Jr. Chem. and Met. Engineering *51*, 126–31 (Oct. 1944). Data concerning plant investment and production costs for butadiene, styrene, butadiene-styrene copolymer (GR-S), Neoprene-GN and Butyl rubber in government-owned plants are presented. The total government investment is approximately $700,000,000. The estimated production cost of GR-S rubber is approximately 12 cents per pound. At the present time butadiene from alcohol costs approximately five times as much as butadiene from butylene dehydrogenation would cost.

EFFECT OF TEMPERATURE UPON THE MECHANICAL PROPERTIES OF RUBBERLIKE MATERIALS. W. P. Fletcher. Nature *153*, 341–2 (1944). The dynamic modulus values of Neoprene-E, GR-S and natural rubber compounds were determined by testing cylindrical blocks at 2 to 60 cyc. per sec. at 5 to 40°C. The dynamic modulus values have a high temperature coefficient.

PLASTICS DIGEST

This digest includes each month the more important articles of interest to those who make or use plastics. Mail request for periodicals directly to publishers.

General

VINYL BUTYRALS IN THE RUBBER INDUSTRY. D. S. Plumb. Ind. Eng. Chem. *36*, 1035–8 (Nov. 1944). Polyvinyl butyrals are clear, tough, hard, light amber colored solids. They are usually compounded with plasticizers, curing agents, fillers, colors, stabilizers and lubricants for use. The resins may be processed on the same equipment used for rubber. Chief uses are in safety glass, in coated fabrics and as films.

PRINTING AND DYEING RAYON AND OTHER SYNTHETICS WITH PIGMENT COLORS. W. W. Chase. Rayon Textile Monthly *25*, 459 (Sept. 1944). The use of pigment colors in printing and dyeing of synthetic fibers is discussed.

THE LAMINATION OF COTTON FABRICS. R. N. Prince and J. Seiberlich. Rayon Textile Monthly *25*, 447–8 (Sept. 1944). Seven different styles of cotton fabrics were laminated with a phenolic resin and the properties of the laminates determined.

RAYON – A PRODUCT OF AMERICAN CHEMURGY. L. Whitney. Rayon Textile Monthly *25*, 425–8 (Sept. 1944). A review of developments during the past year in rayon.

PROGRESS IN THE DYEING OF SYNTHETIC FIBERS. L. Fusser and H. E. Hager. Rayon Textile Monthly *25*, 455–8 (Sept. 1944). Dyeing techniques for rayon, cellulose acetate, nylon, vinyl resin, as well as casein and glass fibers are described.

WAR LENDS IMPETUS TO PROOFING FINISHES. C. N. Rabold. Textile World *94*, 90–2 (Aug. 1944). The flameproofing, mildewproofing and waterproofing of cotton fabrics is discussed. Fabrics are flameproofed with various inorganic salts and chlorinated paraffins. Various substituted phenols, organo-copper salts, organo-mercury salts and organic compounds containing nitrogen are used for mildewproofing. Vinyl resins and synthetic rubbers are used for waterproofing.

DAMAGE FROM AIR BLAST, PROGRESS REPORT II. Bureau of Mines Report of Investigations *3708*, 50 pp. (June 1943). From the results of tests made with dynamite fired in open air the following conclusions were made: 1) Attenuations of pressure with distance greater than the inverse square were observed. 2) Doubling the weight of the charge increased the maximum pressure by approximately 50 percent. 3) Orientation of the dynamite has no effect on the pressure wave under the conditions described. 4) The presence of building walls produces a definite decrease in the maximum pressure obtained within, even with window failure, and also decreases the rate of change of pressure with time. 5) On an equal-weight basis, standard nitro-glycerin dynamite produces higher maximum pressures than commercial gelatin dynamite. 6) The effect of reflections on open-air shots is important in that they influence the measurements. Ground-reflected pressure pulses are transmitted with an attenuation that depends on the angle of incidence; the reflection loss encountered will vary between wide limits. 7) Window glass failure occurs before any other structural failure and damage may be expected when the maximum pressures are between 1 and 2 p.s.i. cf. "Antiscatter Treatments for Glass," Modern Plastics *22*, 162 (Nov. 1944).

Materials

PREPARATION AND PROPERTIES OF SECONDARY AND BRANCHED-CHAIN ALKYL ACRYLATES. C. E. Rehberg, W. A. Faucette and C. H. Fisher. J. Am. Chem. Soc. *66*, 1723–4 (Oct. 1944). Various secondary and branched-chain alkyl acrylates are prepared in high yields by the alcoholysis of methyl acrylate. These acrylates were emulsion polymerized and the brittle points of the polymers were determined. All the polymers were soft, flexible and extensible at room temperature but became brittle at 0° C. and lower. In an homologous series, an increase in the length of the principal chain of the alkyl group to about 8 carbon atoms lowers the brittle point. The esters of unbranched secondary alcohols have considerably higher brittle points than the isomeric esters prepared from primary *n*-alkanols. An increase in branching in the alkyl group also raises the brittle point. The acrylic esters have brittle points much lower than those of the corresponding methacrylic esters.

LACTOPRENE – NEW SYNTHETIC RUBBER. C. H. Fisher, W. C. Mast, C. E. Rehberg and L. T. Smith. Ind. Eng. Chem. *36*, 1032–35 (Nov. 1944). Acrylic ester copolymers containing vulcanizable unsaturation were prepared by polymerizing methyl acrylate or ethyl acrylate with small quantities of polyfunctional monomers, such as butadiene, isoprene and allyl maleate. Compounding the soft copolymers with sulfur and accelerators, followed by curing, produced rubbery vulcanizates. Several abundant carbohydrates can be converted through lactic acid as an intermediate, into approximately an equal weight of vulcanized acrylic resins. Because of the key role played by lactic acid in this transformation, the name "Lactoprene" is proposed for synthetic rubber of this type.

FURTHER STUDIES ON THE QUALITY OF SULFONAMIDE RESINS. W. Scheele, L. Steinke and M. Alfeis. Kolloid-Z. *100*, 361–8 (1942). Procedures for synthesizing resins from various sulfonamides are given. At constant temperature, the viscosity decreases as the acid amide content increases. The viscosities of the various resins are about equal when the molar ratios are the same. Resin formation probably occurs through the sulfonic group of the methylene compounds.

THE SYNTHESIS OF ACETALS OF POLYVINYL ALCOHOL. S. N. Ushakov, I. F. Markov and E. P. Chilina. J. Chem. Ind. (U. S. S. R.) *18*, No. 12, 19–24 (1941); Chem. Abstracts *38*, 3953–4 (Aug. 20, 1944). Polyvinyl acetal is prepared by treating solutions of polyvinyl acetate in ethyl alcohol with paraldehyde in the presence of hydrochloric or sulfuric acid at 65° C. The product is suitable as a substitute for shellac. The effects of the amount of catalyst, the time of reaction, and the use of other reactants are reported.

PREPARATION OF VISCOUS PHENOLIC RESINS. P. O. Powers. Ind. Eng. Chem. *36*, 1008–12 (Nov. 1944). Viscous resins may be prepared by condensing heat-reactive phenolic resins with rosin derivatives. A relatively large proportion of the commercially available phenolic resins of this type is required to produce viscous condensates. Somewhat more viscous products may be obtained by using low-stage reaction products of formaldehyde and para-substituted phenols with an alkaline catalyst. However, to form highly vis-

cous condensates with a moderate proportion of phenolic resin, a mixture of phenols with 2 or 3 positions available for reaction with formaldehyde is used as the starting material for the reactive resin. Condensation products of such resins from mixtures containing 25 to 67 mole percent trireactive phenol have been prepared. The viscosity of the condensate with rosin increases with the amount of trireactive component. These highly viscous condensates cannot be esterified with glycerol since gelation occurs before the reaction proceeds very far. They can be dispersed in drying oils and can be subsequently esterified with glycerol.

Molding and fabricating

MULTI-PURPOSE INJECTION MOLDING MACHINE OPENS NEW FIELDS FOR PLASTIC ARTICLES. Product Eng. *15*, 738–9 (Nov. 1944). The Cousino injection molding machine which utilizes a feed screw of special design instead of the conventional plunger-cylinder device is described. This introduces continuous volume-flow in injection molding. The equipment can be used for extrusion also.

UNORTHODOX PLASTICS DESIGNS. K. T. Barrett. Machine Design *16*, 85–90 (Oct. 1944). Several unorthodox "molded-in" constructions are described. "Mold-in" construction is the molding of plastic parts into shapes which dispense with the need for additional parts, particularly various kinds of fastening devices. The products described include a camera, a pushbutton, and a box with a hinged top. In designing parts utilizing molded-in construction, the wall on which the projection or depression is located must be thin in proportion to its length. The design must also permit mold construction that will allow knockouts to be applied near the area where the projection or depression is located. Stripped undercuts or projections of 0.005 to 0.015 in. are used; the dimension depends on the material and size and design of part.

MACHINING OF PLASTICS WITH CERAMIC TOOLS. Plastics (London) *8*, 509–14 (Nov. 1944). This is a translation of an article by W. Osenberg in "Maschinenbau der Betrieb" *17*, 127–30 (1938). Various metallic and ceramic tools used for machining plastics were investigated. The tool materials include tool steel, tungsten steel, steatite, sintered alumina, fused alumina, tungsten carbide, boron carbide and ceramic tools with alumina and boron carbide cutting edges. The plastic materials used in the tests include three phenol-formaldehyde plastics, a molded material containing a highly abrasive filler, a cast material and a fabric laminate. The wear of the cutting edge was determined by measuring the reduction of area of the vertical plane of the tool. Considerable variations were found with regard to the life of the various tools as well as the comparative figures of wear for the various plastics. It is not advisable to increase the cutting speed to an unlimited extent, particularly when using tool and high-speed steels.

Applications

PLASTIC FINISHING OF METAL PRODUCTS. H. F. Reves. Metal Finishing *42*, 647–9 (Oct. 1944). A hot-melt plastic composition for temporary coating of metal parts to protect them from injury during handling and transport is described. This composition consists of 25 percent ethyl cellulose, 25 percent resin and plasticizer and 50 percent mineral oil and wax; 1 percent stabilizer may be added also. The melt is applied by dipping the article in the molten plastic at 350 to 375° F. The technique of application in production is described. The details of the War Department Ordnance Specification for the composition are reported.

NEW RIVET IS PLASTIC. Aviation *43*, 203 (Oct. 1944). Plastic rivets for attaching fabric to metal, wood or plastic are described. The new rivets are made of acrylic, ethyl cellulose or cellulose acetate butyrate plastic. The acrylic plastic rivets have the best overall characteristics. Metal-plated plastic rivets are also used. The rivets have center-bored bodies and are expanded by compressed air.

NEW VINYL PACKAGING MATERIALS. M. S. Moulton. Modern Packaging *18*, 131–2, 166–8 (Nov. 1944). Packaging materials made of polyvinyl chloride and of vinyl-vinylidene chloride copolymers are described. These resins are used as unsupported films which are made by casting from a solution or from a latex or by hot calendering. They can be spread on paper or fabric by means of a solution, or a latex, or by hot calendering. They can also be used for impregnations to provide sealants with considerable resiliency. The tensile strength, elongation, resistance to abrasion and tear resistance of the compositions are good. The resins are tasteless, odorless, non-toxic, nonflammable and are not deteriorated by fungi. They are resistant to the action of oils, greases and most corrosive chemicals including acids, alkalis and oxidizers.

POST-WAR DESIGNS. W. Nichols. British Plastics *16*, 334–8, 382–9 (Aug., Sept. 1944). The first part of this article discusses several designs by American designers of plastic products. The products discussed include automobile bodies, power boats, supports for pianos, chairs and tables, vases, lighting reflectors and fixtures, radio cabinets, cash register housings, luggage, padlocks, scale housings, kitchen beater housings, sewing machine housings and typewriter housings. American designers stress that plastic products must be designed as carefully as any other product to avoid misuse. The second part of the article discusses several designs of British origin. These include car bodies, truck bodies, beer barrels, furniture, micrometers, greenhouses, paneling and home decorations, motorcycle sidecars, barometer cases, clock cases, and golf bags.

HOT DOPING PROBLEMS SOLVED BY NEW PLASTIC. R. H. Natwick, Aviation *43*, 178, 265–6 (Aug. 1944). A flexible hose lining made of a vinyl plastic is recommended for hot-doping equipment. This plastic is unaffected by the hot dope.

SEALING SURFACES WITH FURFURAL RESINS. J. Delmonte. Plastics *1*, 39–40, 99 (Oct. 1944). Furfural resins are recommended for coating wood and concrete surfaces to render them impervious to acids, organic solvents, water and gasoline. The furfural resins are also recommended for molding, laminating, casting and impregnating. They also are used extensively as adhesives.

Coatings

EXTRACTION OF ALKYD RESINS. H. J. Wright and R. N. Du Puis. Ind. Eng. Chem. *36*, 1004–8 (Nov. 1944). The problem of extracting alkyd resins with lower monohydric alcohols was investigated. Factors such as methods of preparation, degree of polymerization, excess hydroxyl and carboxyl groups, oil length, fatty acid modifiers and substitution of other polyhydric alcohols for glycerol in the resins were studied to find the amounts of extractable material present when such conditions were varied. Films were prepared from fractions of the resins extracted, by both baking and air drying, and were stored under controlled humidity conditions. The alcohol-insoluble fractions of alkyd resins dried more rapidly and to harder films than the original alkyds from which the fractions were obtained. None of the films showed any sign of brittleness. Films from the alcohol-soluble fractions remained soft and tacky. Analyses of fractions showed that alkyds are probably mixtures of resins of various oil lengths and that the shorter oil length portions comprise the unextractable material. The extractable portions of alkyd resins may be useful as plasticizers.

CENTRIFUGAL FINISHING. J. E. Hyler. Metal Finishing *42*, 650–2 (Oct. 1944). The use of centrifugal machines for drying organic finishes is described.

U. S. Plastics Patents

Copies of these patents are available from the U. S. Patent Office, Washington, D. C., at 10 cents each

POLYVINYL ALCOHOL. C. A. Thomas and S. B. Luce (to Monsanto Chemical Co.). U. S. 2,360,308, Oct. 10. Polyvinyl alcohol is prepared by hydrolyzing polyvinyl formate in an aqueous medium containing formic acid.

ADHESIVE. C. F. Van Epps (to Lauxite Corp.). U. S. 2,360,376, Oct. 17. A water-soluble phenolic resin adhesive consisting of the heat reaction product of a phenol such as orthocresol or xylenol, another phenol, formaldehyde and caustic soda.

COMPOSITION. H. M. Weber (to Prolamine Products, Inc.). U. S. 2,360,382, Oct. 17. A thermosetting composition comprising zein dissolved in heat-softened shellac.

FILMS. H. Dreyfus, R. Moncrieff and C. W. Sammons (to Celanese Corp. of America). U.S. 2,360,406, Oct. 17. A process for forming threads, foils, yarns, etc., from a solution of a polyamide.

ACETALS. J. Dahle (to Gustavus J. Esselen, Inc.). U.S. 2,360,477, Oct. 17. A monomeric acetal is reacted with a solid aliphatic substance containing hydroxyl groups in the presence of sulfuric acid to give a by-product alcohol which is reacted with an aldehyde.

COATING. F. A. Bent and G. A. Stenmark (to Shell Development Co.). U.S. 2,360,540, Oct. 17. A coating comprising a polyvinyl formal resin dissolved in 1,2,3-trichlorobutane.

POLYMERS. M. D. Mann, Jr., and L. B. Turner (to Jasco, Inc.). U.S. 2,360,632, Oct 17. In the preparation of isoolefin polymers with a Friedel-Crafts catalyst, the products are contacted with an alkali mixed with a hydrocarbon oil.

PHENOLIC RESIN. D. S. Bruce and R. T. Halstead (to Johns–Manville Corp.). U.S. 2,360,645, Oct. 17. A molding mixture consisting of asbestos fibers, phenol-formaldehyde resin and free sulfur as a color stabilizer.

SHEETING. P. W. Crane (to E. I. du Pont de Nemours and Co., Inc.). U.S. 2,360,650, Oct. 17. The adhesiveness of plasticized polyvinyl acetal sheeting is reduced by treating with solvent under tension, removing solvent and finally drying.

SHEETING. L. Paggi (to E. I. du Pont de Nemours and Co., Inc.). U.S. 2,360,712, Oct. 17. The adhesiveness of plasticized polyvinyl butyral sheeting is reduced by treating the surface with a solution of a halogen acid or sulfuric, nitric, acetic, or formic acids.

METHACRYLATES. E. L. Kropa (to American Cyanamid Co.). U.S. 2,360,880, Oct. 24. A lower alkyl ester of methacrylic acid is prepared by heating the corresponding ester of alpha-hydroxy isobutyric acid with benzotrichloride.

COATING. A. Hershberger (to E. I. du Pont de Nemours and Co., Inc.). U.S. 2,360,947, Oct. 24. Regenerated cellulose is coated with a moistureproof coating comprising rubber hydrochloride, gum damar, montan wax and benzyl abietate.

WELDING. F. P. Kilgour (to E. I. du Pont de Nemours and Co., Inc.). U.S. 2,360,950, Oct. 24. A heat-conducting tool for the welding of thermoplastic organic material.

SYNTHETIC MATERIAL. P. J. Dasher (to B. F. Goodrich Co.). U.S. 2,361,015, Oct. 24. Vulcanized balata is heated with an aliphatic polyamine at 200° F. until the balata becomes plastic.

RESIN. H. L. Gerhart (to Pittsburgh Plate Glass Co.). U.S. 2,361,019, Oct. 24. A tough, hard, resinous material is prepared by copolymerizing a polymerizable hydrocarbon consisting of a 2-phenyl substituted monoolefin, an ester of an alcohol containing two or three hydroxyl groups, and an unsaturated dicarboxylic acid or the corresponding anhydride.

ACRYLATE POLYMERS. M. A. Pollack (to Pittsburgh Plate Glass Co.). U.S. 2,361,055, Oct. 24. A method for preparing substantially insoluble and infusible polymers of acrylic acid esters.

LEATHER TREATMENT. W. D. Kennedy. U.S. 2,361,296, Oct. 24. Leather is coated with a pliable thermoplastic material after which vapors of a solvent for the material are passed through the pores to prevent clogging.

PLASTICIZER. P. C. Schroy (to American Cyanamid Co.). U.S. 2,361,322, Oct. 24. A thermosetting resin is plasticized with an N–ethanol carboxylic acid amide.

THERMOPLASTICS. J. J. Grebe and E. H. Harder (to Dow Chemical Co.). U.S. 2,361,369, Oct. 31. A device for producing reticulated articles from thermoplastic materials.

VINYLIDENE CHLORIDE. A. W. Hanson (to Dow Chemical Co.). U.S. 2,361,371, Oct. 31. Fabric comprised of threads of vinylidene chloride is heated under pressure in order to reduce the thickness of the fabric.

ADHESIVE. J. E. Robinson (to American Can Co.). U.S. 2,361,418, Oct. 31. Adhesive for fiber containers, etc., of polyvinyl acetate and pine wood pitch.

PLASTIC. P. S. Turner. U.S. 2,361,438. A lightweight structure composed of a phenol-formaldehyde resin in which are embedded starch granules.

CELLULOSE ESTERS. R. D. Rowley (to Celanese Corp. of America). U.S. 2,361,500, Oct. 31. Cellulose esters of improved stability are prepared by esterifying and ripening in several stages, the final stage of which is effected in presence of aliphatic polycarboxylic acid.

VINYL COPOLYMERS. W. Scott and R. B. Seymour (to Wingfoot Corp.). U.S. 2,361,504, Oct. 31. Copolymerized vinyl chloride and vinyl bromide polymerized to a degree which would render the vinyl chloride insoluble in ethylene if polymerized alone.

ADHESIVE. F. S. Bacon (to Monsanto Chemical Co.). U.S. 2,361,527, Oct. 31. An adhesive for fibrous material consisting of a polyvinyl acetal resin and an inert inorganic pigment.

UREA - FORMALDEHYDE LACQUERS. R. C. Swain and P. Adams (to American Cyanamid Co.). U.S. 2,361,715, Oct. 31. Low viscosity lacquers are prepared by reacting urea with formaldehyde, refluxing with a water-immiscible monohydric alcohol and dehydrating.

POLYAMIDES. G. B. Taylor (to E. I. du Pont de Nemours and Co., Inc.). U.S. 2,361,717, Oct. 31. Polyamides are prepared by continuously passing an aqueous solution of a diamine dicarboxylic acid salt at superatmospheric pressure through several reaction chambers at the heat for amide formation.

ION EXCHANGE RESIN. R. McFarland, Jr. U.S. 2,361,754, Oct. 31. An ion exchange resin comprising a sulfonated ground monohydric phenol-formaldehyde resin.

BOOKS AND BOOKLETS

Write directly to the publishers for these booklets. Unless otherwise specified, they will be mailed without charge to executives who request them on business stationery. Other books will be sent post-paid at the publishers' advertised prices.

Standardization of Volumetric Solutions

by R. B. Bradstreet

Published by Chemical Publishing Co., Inc., Brooklyn, N. Y., 1944

Price $3.75 **151 pages**

Analysts and research workers in the laboratory will appreciate this manual of directions for the preparation of standard chemical solutions and tables of pertinent data. G.M.K.

Chemical Machinery

by E. R. Riegel

Reinhold Publishing Corp., New York, N. Y., 1944

Price $5.00 **583 pages**

This elementary treatise on equipment for large-scale production operations in the chemical industries provides a time-saving up-to-date survey of the field for chemical engineers. Each chapter has a tabular classification of the related devices available for the particular operation under discussion. G.M.K.

Cumulative Index for the Chemical Formulary

by H. Bennett

Chemical Publishing Co., Inc., Brooklyn, N. Y., 1944

Price $4.00 **164 pages**

This cross-referenced index of Volumes I to VI, inclusive, of the Chemical Formulary simplifies location of information on specific subjects in this useful compendium of chemical technology. G.M.K.

The Chemistry of Synthetic Substances

by Emil Dreher; translation by M. L. Taylor

Published by The Philosophical Library, New York, N. Y., 1943

Price $3.00 **103 pages**

The papers on the chemistry of high polymers which are compiled in this book were first published separately in Germany in 1937 and 1938 and as a book in 1939. For that reason the subject matter is not as up-to-date and complete as that of books in the same field published in this country during recent months. However, the condensed treatment of the principles and factors involved in polymerization and of the application of high polymers as film-forming materials may be of interest to some readers. G.M.K.

Handbook of Engineering Plastics

by D. Warburton Brown, A.M.I.A.E.

Published by George Newnes Limited, Tower House, Southampton Street, Strand, W. C. 2, Great Britain

This is Volume II of a treatise on plastics, first published in 1943. The contents appear to fall into two fields: one, materials, their properties, tests and specifications; and two, different applications for various types of materials and procedures in their molding and also in their handling.

The approach in this book, rather than being one of general interest, is pointed directly toward the engineer and, particularly, at the engineer with little if any knowledge of these materials. The six major topics relating to material properties and tests are as follows: Introduction, Materials and Manufacture, Physical Properties of Plastics, Fatigue Properties of Plastics, Creep and Cold Flow of Plastics, and Tests and Specifications. The nine topics relating to applications and procedures are: Plastics for Gears, Plastics for Bearings, Transparent Plastic Models, Metal Coating of Plastics, Machining of Plastics, Improved Wood, Synthetic Adhesives, Molds and Mold Design, and Plant and Equipment. The physical properties of plastics are covered by 39 tables, the first 15 of which compare certain properties against many types of materials, while the latter 24 tabulate properties of specific materials. This breakdown makes it very simple for the engineer to spot the exact property of a certain material if he should need it, or to make a very quick comparison of a certain property.

The author has drawn widely from the knowledge of various leaders in their specific fields in order to make the information contained in this handbook as authoritative as possible. He is to be congratulated upon gathering together into 212 pages a most interesting compilation of plastics information. F.B.S.

★ A SUMMARY OF THE PROPerties and use of Ucilon, a new protective coating, is the subject of a brochure released by United Chromium, Inc., New York, N. Y. This coating, an outgrowth of many years of intensive research, is said to be resistant to acids, alkalis, salts, cleaning compounds and alcohols. A special formulation is used for contact with food products. Among the coating's outstanding properties are absence of taste or odor, dielectric strength, flexibility, acid resistance, gloss and color, toughness and non-toxicity.

★ A BRIEF HISTORY OF THE developments of the byproduct coke oven and a summary of the latest methods of coking are presented in an attractively illustrated book published by Koppers Co., Pittsburgh, Pa. Cross-section diagrams and numerous pictures heighten the interest of the book. However, copies of this book are not generally available.

★ "RESEARCH IN ACTION," AN illustrated booklet released by Battalle Memorial Institute, Columbus, Ohio, reviews the institute's fifteen years of service to the industrial world. Action photographs accompanying the text cover in detail the work presently in progress.

★ USES OF AMERCOAT IN A wide range of industries are described in a new catalog on Amercoat plastic coatings issued by American Pipe and Construction Co., Los Angeles, Cal. A comprehensive list of organic and inorganic materials, foods and beverages and actual equipment and structures that are now being protected against corrosion or contamination, is included.

★ TWO TECHNICAL BOOKLETS on ethyl cellulose — "The Properties and Uses of Ethyl Cellulose" and "Ethyl Cellulose Formulations with Resins and Plasticizers" — have been published by Hercules Powder Co., Wilmington, Del. Properties such as low flammability, freedom from discoloration by sunlight, toughness and flexibility, heat resistance and usefulness in the formulation of plastics are covered in the first book. The latter brochure is intended to eliminate unnecessary research for formulations by providing a basis of ethyl cellulose lacquers, adhesive plastics and hot-melt coatings. Seven tables showing test results and comparison formulas, are included. (*Please turn to next page*)

★ A SYSTEM WHICH IS SAID TO be the answer to waste in manufacture due to lack of standardization, is outlined in "The Turner System of Materials Handling," a brochure issued by Factory Service Co., Milwaukee, Wis. Features of the Turner System are: transport, jimmy, bin sections and section trays, stacking shop boxes, shop box racks, die tables and trays, slide and lift shelf racks, superstructures, crane trays and stacking units, folding stakes, pallets and platforms.

★ B. F. GOODRICH CO., AKRON, Ohio, has issued a 2-page leaflet on the "Property Relation of Natural and Synthetic Rubber." The material is arranged in tabular form for ready reference.

★ 1583 USES FOR GLYCERINE are listed in a recent booklet, entitled "Nothing Takes the Place of Glycerine," published by the Glycerine Producers' Association, New York, N. Y. A section on its use in plastics and molding compositions includes its place in casein plastics plasticizer and glue compositions, as a heating medium and in the formation of melamine compositions and alkyds.

★ A 60-PAGE, COMPLETELY-illustrated book has been prepared by Aldrich Pump Co., Allentown, Pa., on its line of pumps and hydraulic equipment. The text is divided into three parts: the first containing complete and authoritative hydraulic information and tables; the second being devoted to manufacturing facilities and the third containing a catalog of Aldrich pumps and hydraulic equipment.

★ SIX NON-METALLIC BASIC materials are covered in a recent publication of Continental-Diamond Fibre Co., Wilmington, Del., referred to as GF 28. These include Diamond vulcanized fibre, Dilecto, Dilectene, Celoron, Micabond and Vulcoid. Besides a listing of the properties of each material, the booklet contains application photographs.

★ CARBORUNDUM CO., NIAGARA Falls, N. Y., has prepared a 136-page reference book on grinding. Included in this book are a complete explanation of the new marking symbols, a comprehensive schedule of grading recommendations for general, toolroom, diamond wheel and thread grinding, a description of each common type of grinding, safety rules and a table of speeds.

★ FOR ECONOMICAL UTILIZATION of infrared radiant energy, Fostoria Pressed Steel Corp., Fostoria, Ohio, suggest, in a recent bulletin, the use of their evenray system for baking, dehydrating, preheating and drying. The following important production benefits are claimed for this system: saving of time and space, reduction of rejects, instant production, no stand-by loss, visible operation, greater flexibility, economy of operation, worker comfort and lower investment.

★ THREE NEW ATTACHMENTS for the No. 5 Universal Turret Lathe manufactured by Warner & Swasey Co., Cleveland, Ohio — a selective quick change gear box for universal threading turret lathes, a thread chasing attachment with automatic knockoff and an electric collet chuck booster — are described and illustrated in a recent catalog received from the manufacturer. Included in the catalog is a specification chart and a list of the complete line of turret lathes produced by this company. Numerous photographs show the various uses of the machines.

★ TYPE 6 NAO PALNUT, DESIGNED for use either as an adjustment nut or as a self-locking nut for lightweight assemblies, is the subject of a 4-page bulletin, recently released by Palnut Co., Irvington, N. J. Features claimed for this model are: a triple grip on bolt thread; a 60 to 70 percent saving in weight as compared with other devices; ability to lock anywhere on the bolt and maintain any desired position; resistance to higher temperatures; and lower cost than other self-locking nuts.

★ IN A RECENT BULLETIN, PORTER-CABLE Machine Co., Syracuse, N. Y., described a new precision machining method for which it claims the following outstanding results: limits as close as 0.0005 in.; the working of an entire area at one time; elimination of dust or grit; production of a superior finish in less time than formerly; elimination of heat warping, distortion, discoloring, fracturing and chipping; and saving of material and time.

★ THE LATEST BULLETINS ISSUED by Watson-Stillman Co., Roselle, N. J., 130-A and 520-A, describe valves and forged steel fittings for the process industries and bushing presses for railroad shops.

★ THE END USES OF TULOX plastic tubing are reviewed in an illustrated four-page pamphlet submitted by Extruded Plastics, Inc., Norwalk, Conn. Manufactured from a wide variety of resins, the tubing has all the advantages of the material used and can be colored or colorless, transparent, translucent or opaque.

★ THE PRINCIPLE OF ADJUSTability applied to cutting tools — valuable in wartime and adaptable to reconversion — is fully explained in a new catalogue released by Robert H. Clark Co., Beverly Hills, Calif. The catalog, which is printed in two colors and illustrated with diagrams and operational photographs, contains complete specifications and prices, as well as detailed descriptions of the entire line of adjustable cutting tools made by the company.

★ A 4-PAGE INSERT DESCRIBING two new models of radius dressers, No. 45 and No. 124, has been released by U. S. Tool and Mfg. Co., Dearborn, Mich., for those who have the company's 60-page tool catalog. Model 45, adaptable to all radii up to and including 4½ in., can be used for concave or convex dressing; and Model 124, an angle correcting radius dresser (maximum radius 1⅛ in.), is designed for correcting radius on a wheel for grinding compound and compound complex forms on flat form tools.

★ PULVERIZING MACHINERY Co., Summit, N. J., describes its complete line of Mikro-pulverizers in a recently published catalog. The brochure, which is the most complete ever issued by the company, covers the basic features of construction and design of each model, and lists also the many possible applications of the machines.

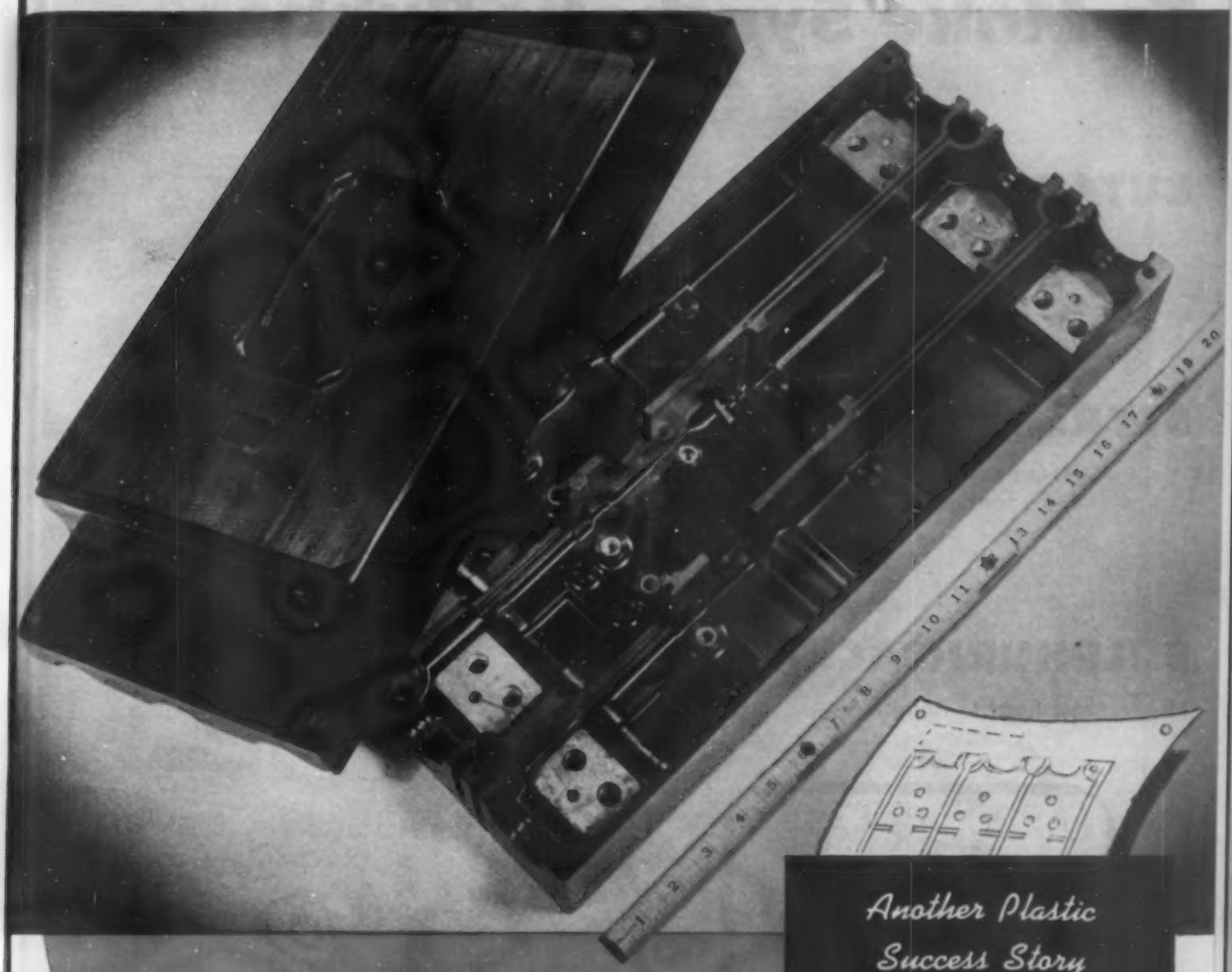
★ TWO PAMPHLETS ON MEGAtherm heating: Megatherm Type MD-3A, and Megatherm — high speed, uniform, electronic heat, have been received from Federal Telephone and Radio Corp., Newark, N. J. Both contain data on the special features, design and use of these units.

★ HOWE SCALE CO., RUTLAND, Vt., has issued a fully illustrated catalog describing its line of warehouse trucks, trailers, dollies, platform skids, lift jacks, wheel axles and casters. Complete specifications for each product are listed.

★ A 32-PAGE BULLETIN, WHICH discusses details of the latest developments in Banbury mixers, has been received from Farrel-Birmingham Co., Inc., Ansonia, Conn. The brochure describes the many applications possible with the use of this machine, as well as features of its design and construction. Photographs and blueprints illustrate various sizes and types of machines available for different applications.

★ SUPPLEMENTING CATALOG No. 39 of Chicago-Latrobe Twist Drill Works, Chicago, Ill., is made up of two pamphlets describing carbide-tipped tools and spiral-fluted checking reamers.

A 20 Inch IDEA... Molded in PLASTICS



Diversity in size and quantity of plastic products produced by Tech-Art run the full commercial scale. In sizes they range from minute highly technical pieces to the very largest units being produced. Numerically these produts are sometimes molded by Tech-Art in relatively small amounts or, as in the case of widely used consumer goods, in quantities that approach box car figures. Every conceivable type of molding practice is performed at Tech-Art, utilizing hand molds, semi-automatic and fully automatic molds in both compression and compression transfer types of molds. In injection molding Tech-Art's facilities include a battery of the most modern injection presses. But back of all these facilities stands Tech-Art's broad experience in product engineering, a highly developed knowledge that assures the success of thousands of plastic products before they ever leave Tech-Art's drafting boards.

Another Plastic Success Story

A nationally known Switch-Gear Manufacturer brought to Tech-Art the problems of molding this twenty-inch long circuit-breaker box. Large and costly molds were required that called for master craftsmanship in mold building. Presses employing great pressure were a "must" in this molding operation. Both, together with the acme of perfection in plastic engineering, were found at Tech-Art. The result—as you see here—another Tech-Art Plastic Success Story.

TECHNICAL NOTES: These pieces, approximately twenty inches long and weighing seventeen pounds, were molded from high impact materials in very large presses. Electric holes and power knockouts with electronic heating aid contributed to the variety of equipment needed to produce these parts.

TECH-ART PLASTICS COMPANY

36th Ave. and 41st Street • LONG ISLAND CITY, N. Y. • Tel. AStoria 8-6050-1

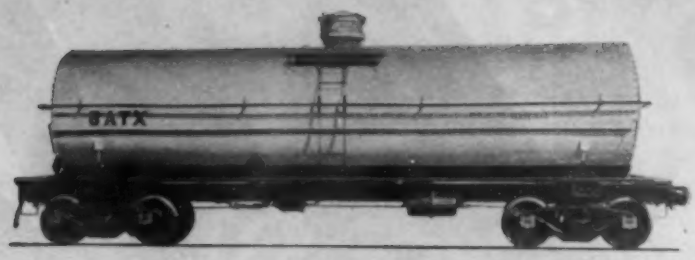
SUCCESSORS TO BOONTON RUBBER MANUFACTURING COMPANY

PIONEER PLASTIC MOLDERS . . . Established 1891

To Make Synthetic Rubber...

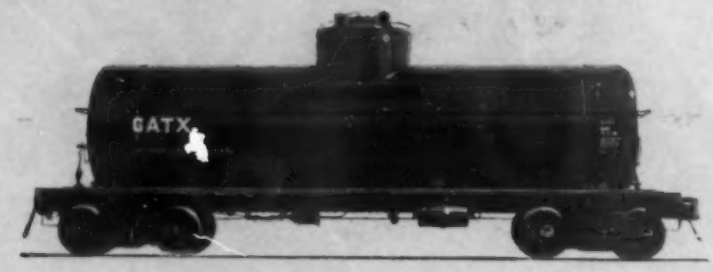
BUTADIENE...

must be carried at high pressure



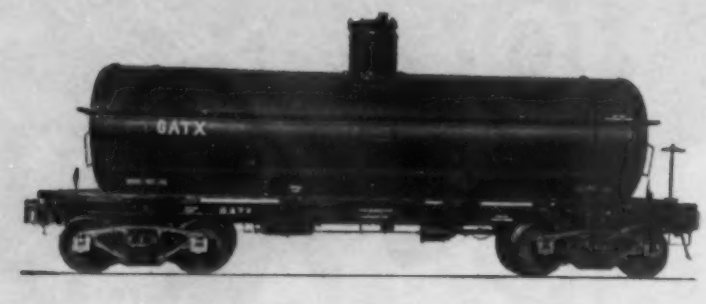
STYRENE...

requires special protection



SULPHURIC ACID...

is hard to handle



For Your Postwar Products

General American engineers are ready now to consult with you—to plan new tank cars with every feature needed to transport your products safely. Call or write our general offices—135 South LaSalle St., Chicago 90, Ill.

GATX GENERAL AMERICAN

There are General American tank cars with the correct protective features for each component of synthetic rubber. GATX cars are giving safe and sure transportation—to help in reaching the high goals of the synthetic rubber industry.

GENERAL AMERICAN TRANSPORTATION CORPORATION

Builders and Operators of Specialized Railroad Freight Cars ★ Bulk Liquid Storage Terminals ★ Pressure Vessels and other Welded Equipment ★ Aerocoach Motor Coaches ★ Process Equipment of all kinds ★ Fruit and Vegetable Precooling Service

IT'S A TIME SAVER!

So long as his plant stuck to slotted screws, this assembly man had to stick to hand driving. Too much danger of power drivers skidding and gouging the carriage's finished surface – making costly refinishing necessary.

IT'S A MONEY SAVER!

A shift to Phillips Screws permitted a switch to power driving. Thanks to the Phillips Recess, driver skids stopped. Result: a fast, money-saving process instead of a slow, high-cost hand operation!

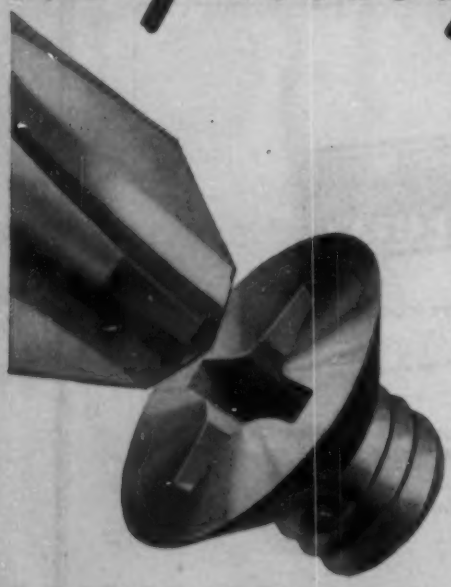
IT'S A PROBLEM SOLVER!

Management and workers aren't the only ones who benefit from Phillips Screws. Design Engineers find there's no easier way to plan extra fastening strength and rigidity into a modern streamlined product – and to lower costs at the same time!

IT'S A SALES BUILDER!

To salesmen, too, use of Phillips Screws pays dividends: in a stronger, smarter product . . . that has no burred screw heads to disfigure surfaces and snag clothing. Ornamentally as well as functionally, this recess is engineered to SELL your product!

It's Phillips — the engineered recess!



In the Phillips Recess, mechanical principles are so correctly applied that every angle, plane, and dimension contributes fully to screw-driving efficiency.

. . . It's the exact pitch of the angles that eliminates driver skids.

. . . It's the engineered design of the 16 planes that makes it easy to apply full turning power – without reaming.

. . . It's the "just-right" depth of recess that enables Phillips Screw Heads to take heaviest driving pressures.

With such precise engineering, is it any wonder that Phillips Screws speed driving as much as 50% – cut costs correspondingly?

To give workers a chance to do their best, give them faster, easier-driving Phillips Recessed Head Screws. Plan Phillips Screws into your product now.

PHILLIPS *Recessed Head* SCREWS

WOOD SCREWS • MACHINE SCREWS • SELF-TAPPING SCREWS • STOVE BOLTS

Made in all sizes, types and head styles

24 SOURCES

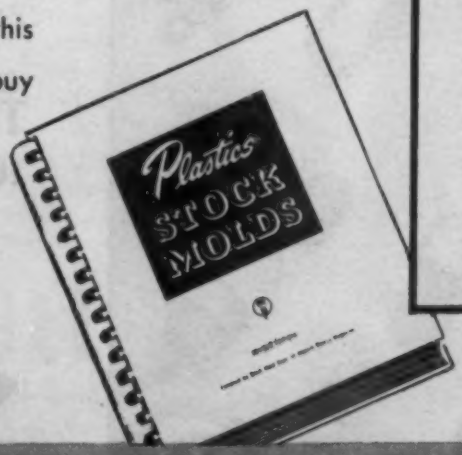
American Screw Co., Providence, R. I.
Atlantic Screw Works, Hartford, Conn.
The Bristol Co., Waterbury, Conn.
Central Screw Co., Chicago, Ill.
Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
The Corbin Screw Corp., New Britain, Conn.
General Screw Mfg. Co., Chicago, Ill.
The H. M. Harper Co., Chicago, Ill.
International Screw Co., Detroit, Mich.
The Lamson & Sessions Co., Cleveland, Ohio
Manufacturers Screw Products, Chicago, Ill.
Milford Rivet and Machine Co., Milford, Conn.
The National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N. H.
Parker-Kalon Corp., New York, N. Y.
Pawtucket Screw Co., Pawtucket, R. I.
Pheoll Manufacturing Co., Chicago, Ill.
Reading Screw Co., Norristown, Pa.
Russell Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Manufacturing Co., Waterville, Conn.
Shakeproof Inc., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Conn.
Wolverine Bolt Co., Detroit, Mich.

"PLASTICS STOCK MOLDS has paid for itself a dozen times over!"

● "Yes, that is a true statement! This catalog 'Plastics Stock Molds' is worth more than its weight in gold to me. Why? Because it leads me directly to ready made molds of practically everything I want in plastics — closures, dozens of 'em, boxes, novelties, etc."

You, too, will find Plastics Stock Molds not only helpful, but vital. It contains nearly 1600 clear photographs of plastics made in available ready made stock molds. Contains nearly 200 standard extruded shapes — including for the first time a comprehensive standardized index of extruded parts. Contains a directory of stock laminated sheets, rods and tubes. Every item in the book is cross indexed by the name of the manufacturer and also by subject. You can use this book as a direct mail order catalog to buy every type of plastic part listed in the box on this page — and more!

- Flashlights
- Shaving Accessories
- Textile Accessories
- Hair Ornaments
- Cosmetic Containers
- Trays
- Office Equipment
- Frames
- Household Products
- Lamp Bases & Accessories
- Plumbing Hardware
- Electric & General Hardware
- Clock Cases
- Medical Applications
- Boxes & Containers
- Handles
- Closures
- Knobs
- Smoking Accessories
- Games & Novelties
- Jewelry



Compiled by Stock Mold Department, Modern Plastics Magazine

$5 per copy.
(foreign $6.)

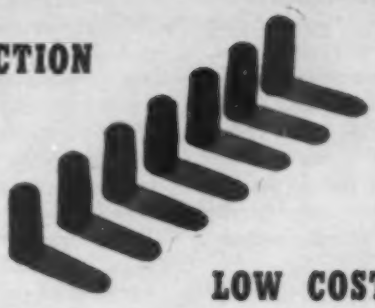
PLASTICS STOCK MOLDS

122 East 42nd Street — New York 17, N. Y.

MOLD AUTOMATICALLY

IT PAYS . . . CASE HISTORIES PROVE IT

BIG PRODUCTION



LOW COST

Esterbrook Pen Co. formerly purchased these cap moldings at $5.95 per M. Rejects were the big problem, for inaccuracies in large, multiple-cavity molds complicated assembly and added to production costs. Now Automatic Molding produces these caps at $2.30 per M. This figure includes material, labor, overhead and amortization of machines and molds. Automatic Molding maintains high quality, simplifies assembly. Two presses produce 20, 300 caps per 24-hour day.

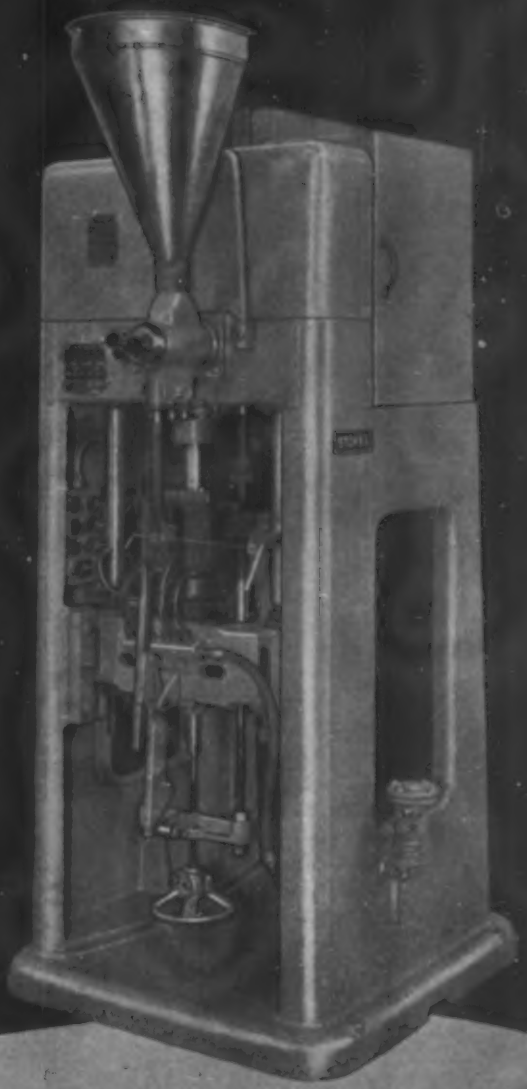
Thus, an investment of $7000. for Automatic Molding Machines and molds, saves this company an approximate $11,000. per year in the cost of moldings alone, plus savings in assembly operations.

BIG PIECE

LOW COST

This Minneapolis-Honeywell thermostat cover is a good example of a part redesigned for Automatic Molding. Originally, it was die-cast. Then it was molded by conventional methods, requiring expensive, complicated molds, with side-draws and hand operation. Production was slow . . . cost high. Now, designed for Automatic Molding, and employing a single-cavity mold, parts are identical, uniform, accurate, require less finishing. Side-draws were eliminated. Rejects are negligible. Cost is considerably less.

F. J. STOKES MACHINE COMPANY
5934 Tabor Road Philadelphia 20, Pa.



Patented in U.S. and abroad. Other patents pending

We suggest you investigate Automatic Molding in terms of parts you may mold by conventional methods or new parts you may need in post-war manufacture. We are prepared to make cost studies and otherwise help you obtain an accurate picture of the possibilities.

F.J.Stokes MOLDING EQUIPMENT

FJS Est. 1895

NEW MACHINERY AND EQUIPMENT

★ A NEW BENCH MACHINE RECENTLY introduced by Denison Engineering Co., Columbus, Ohio, will be of particular interest to the plastics field. Basically an oil hydraulic press, the Multipress will deliver up to 40 tons downstroke pressure and up to 5000 lb. "pull up" pressure even though completely self contained and weighing only 745 pounds. It has been especially designed to utilize a wide

variety of accessories and fixtures with which it is said to perform innumerable production operations, such as pelleting, honing, broching, peening, assembling, burnishing and straightening. The basic manually controlled unit is operated by depressing the control levers to cause the ram to move downward or by releasing either lever to stop the ram instantly. Releasing the other lever causes the ram to return to the upper limit where it is positively held. The ram can be inched downward and positioned exactly above the work before pressure is applied, by slowly depressing the hand levers. Pressures are indicated clearly through the use of the eye level gage.

★ A SPECIAL SET OF TEMPLIN grips for testing in the plastics field has been developed by Baldwin Southwark Div., Baldwin Locomotive Works, Philadelphia, Pa. With this unit it is possible to take a light-weight grip on a 1-in. wide specimen with a maximum capacity of 5000 pounds.

★ A TURRET ATTACHMENT FOR small type drill presses has been developed recently (patent applied for) by Machine Development Co., New York, N. Y., and is designed to enable single-spindle drill presses to be used for multiple-spindle operations. The present Madco model carries six individual spindles and takes drills up to $\frac{1}{2}$ in. in diameter. It can also be used for tapping when the drill press is equipped with a reversible motor. Simple installation is accomplished by attaching the unit to the lower end of the drill press quill by means of a collar that is locked in place with three set screws. To operate, the worker need merely raise the drill press lever, turn the head to the desired station and lower the lever. A ball and detent arrangement indicates when the head is indexed to the correct position and the special clutch device automatically engages and aligns the spindle preparatory to drilling.

★ TO FACILITATE GRINDING OF any type of metal, wood or plastics material, a new all-purpose disk grinder has been developed by Kindt-Collins Co., Cleveland, Ohio. Made in two similar models, the regular type uses cloth or paper abrasive disks while the heavy-duty unit employs an inch-thick grinding disk. Principles of design and construction features are: a 30-in. disk with 26-in. high grinding area; hydraulic controls which eliminate all gears, worms and jack screws ordinarily employed for raising, lowering and tilting the table; an accurate-position stop on the protractor for stopping table in any position from 45° down to 15° up; a ventilated table with properly placed perforations to channel dust into highly efficient dust guards. Paper or cloth disks may be removed and replaced without removing the steel disk.

★ FEDERAL PRODUCTS CORP., Providence, R. I., claims that the fine adjustment of the indicator bracket on their testmaster height gages eliminates "tapping" in adjusting heights. The unit can be set at any angle—down in a hole, sidewise or close to the bracket—and the user need only set to gage blocks or master and check the results.

★ DESIGNED ABOUT THE TWO basic principles of direct and indirect heating methods, with a choice of either gas or electricity as the heating medium, processing tanks and kettles have been produced by Castaloy Corp., Detroit, Michigan. The indirect method is accomplished by enclosing the plastic container within a larger vessel containing Dowtherm E, which boils at 350° F., vapor pressure being approximately 10 lb. at 390° F. By controlling the vapor pressure, temperature range is maintained within extremely close limits.

The direct heating equipment is precision controlled using thermostats mounted on each electric heater to maintain a predetermined temperature ±10° F. The heaters are automatically cut off when the desired temperature for the material being processed is reached.

★ SOUTH BEND LATHE WORKS, South Bend, Ind., announces a new 9-in. toolroom lathe which has a $9\frac{1}{4}$-in. swing and takes 22 in. between centers. The unit has maximum collet capacity of $\frac{1}{2}$ in. and a $\frac{3}{4}$-in. spindle bore. The twelve spindle speeds range from 41 to 1270 r.p.m.—a back-gear drive being provided for the lower speeds. A quick change gear box permits cutting 48 pitches of screw threads, 4 to 224 per in. and provides 48 power longitudinal-feeds and power cross-feeds.

Numerous attachments are available to simplify the machining of special classes of work.

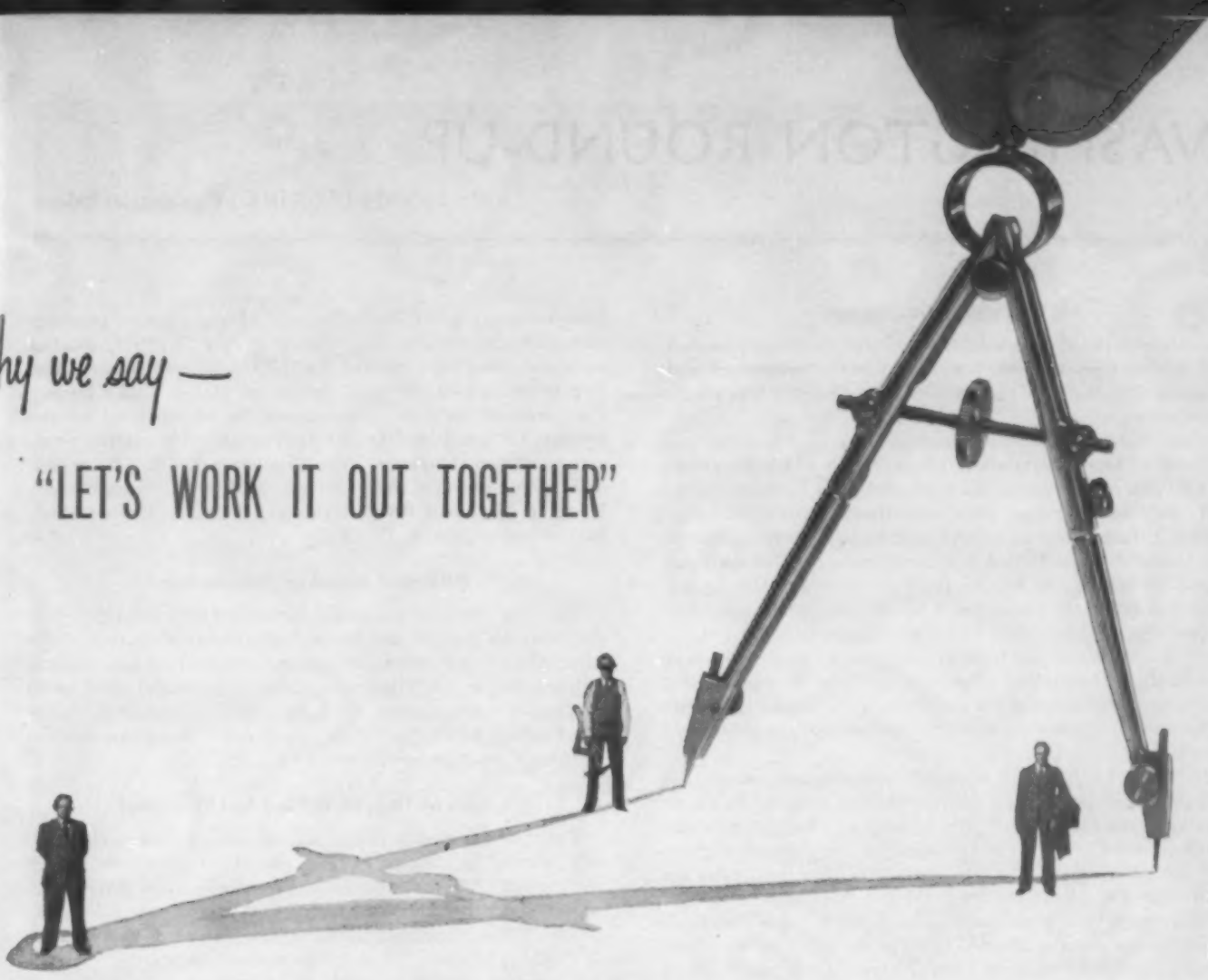
★ R. P. CARGILLE, NEW YORK, N. Y., is manufacturing a portable magnifier, Set No. 44-MP with built-in illuminating units which are operated by battery and by electric control. They contain 7-, 20- and 40-power magnifiers, the 40-power being equipped with a 0.001-in. scale.

The machine is very useful for inspecting surfaces of plastics molds, for precision measurements on tools and dies and measuring details of dimensions not clearly visible to the human eye.

★ SUPPLEMENTING THE REGULAR line of machine tool accessories, Ideal Commutator Dresser Co., Sycamore, Ill., announces a universal 3-jaw chuck, which is inexpensive, yet precision made to assure accurate turning. Rib construction is said to provide ample resistance to shock, load and unusual stress. Two sets of jaws, one for internal and another for external work, are furnished. Thus if a single jaw is damaged, it can very easily be replaced.

why we say —

"LET'S WORK IT OUT TOGETHER"



At Dow, we firmly believe there is one *sure* answer to success in plastics. It's a simple, friendly idea—yet so important that we are putting aside this advertising space to tell you about it.

Our work with many manufacturers and molders all over the country has proved the value of close and continuing cooperation with them in developing nearly every job. As plastics move into a period of even greater usefulness, this teamwork becomes increasingly important; for putting plastics to work *right* is not a one-man job. It is not even a one-industry job. Instead, it calls for the combined skill and experience of manufacturer and designer—working step by step with molder—and Dow.

That's why we say "*Let's work it out together*"—it saves time and money and puts plastics in their right place.

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

New York • Boston • Philadelphia • Washington • Cleveland • Detroit • Chicago • St. Louis • Houston • San Francisco • Los Angeles • Seattle

DOW PLASTICS INCLUDE:

STYRON (Dow Polystyrene)...
For moldings, extrusions, rods, sheets.

SARAN...
For moldings, extrusions, pipe, tubing, monofilaments; also available as Saran Film.

ETHOCEL...
For moldings, extrusions, coatings; available also as Ethocel Sheeting.

DOW

PLASTICS

Styron Saran Ethocel

WASHINGTON ROUND-UP

R. L. VAN BOSKIRK, Washington Editor

Mr. Maverick's plastic houses

Members of the plastics industry were startled recently to read the following quotation which appeared in the newspapers and was credited to Maury Maverick, head of the Smaller War Plants Corporation:

"There will be an enormous postwar market for building materials of all kinds, particularly plastics, with which to rebuild the 4,000,000 homes demolished in Great Britain by aerial bombings. In Western Europe, there's an estimated 40,000,000 homes to be constructed and an untold additional number in Russia. This means that the United States will have to fall back upon its plastics industry to furnish the construction materials; because, if only lumber were used, it would absorb the entire timber production of the United States for a generation."

Mr. Maverick has not been available to your correspondent for a further explanation of this statement, but members of his staff have given us the following interesting explanation of the background that may explain this sensational statement concerning the plastics industry.

Mr. Maverick had just returned from England, where the average layman is all keyed up over plastics, largely because he looks upon the famous Mosquito bomber as a highly successful plastics product. The important thing to the average Englishman, according to our informer, is that the structural parts are plastic-plywood. Therefore, he thinks that such structural members may have great possibilities in the construction field. But this same average layman, when he thinks of plastics, goes considerably farther than the kind of plywood used in the Mosquito. He looks upon such things as Masonite and sometimes even Cemestoboard and almost any kind of wallboard as plastics products. These same Englishmen know that there is going to be an almost unbelievable number of temporary buildings built in England and Europe for the first year or two following the war, and they figure these temporary structures can be built from wallboard—but instead of wallboard they call it plastic. It is possible that Mr. Maverick picked up his enthusiasm for structural plywood and wallboard from Englishmen who were not too accurate in defining what they meant by plastics.

These are supposedly the opinions of laymen. It is not believed that plastics authorities in Great Britain have any idea that they can rebuild 4,000,000 homes with plastics material as a substitute for lumber. Great quantities of plastics can be used in such things as hardware, trim and electrical equipment, but it seems beyond the realm of reason to anticipate the use of plywood in such enormous quantities. In the first place, there simply is not enough capacity to produce it.

SWPC officials were also asked what success they had had in helping small business get into the plastics industry. Officials admitted that plastics seemed a logical field for small business in so far as the processing branch of the industry was concerned, but stated that their efforts have been confined to specialties. At the present time they do not believe it is possible to put new molders into the field on a large scale to make parts for such things as refrigerators and electrical equipment. One of their successful examples which was called to our attention was the use of acrylic scrap for lenses to be used with television sets. However, they asserted that there had been no appreciable progress in their effort to place new operators in the plastics field because they were generally unable to obtain either presses or the necessary raw material.

Plastic shoe heels and soles

Because they are not customarily produced by plastics molders or fabricators, shoe heels and soles made of plastics materials have been exempted from coverage of the plastics products maximum price regulation. Effective Nov. 8, 1944, plastics heels and soles were covered by the General Maximum Price Regulation, which "freezes" prices at March 1942 "highs." Price controls for these products will be administered by the Rubber, Chemicals and Drug Price Branch. The plastics products regulation (Maximum Price Regulation No. 523) has a base date pricing period of Jan. 1 to March 31, 1942. (Amendment No. 3 to Maximum Price Regulation No. 523—Plastics Products—effective Nov. 8, 1944.)

Allocation control on polyethylene

The War Production Board revoked Order M-348 (polyethylene) on Nov. 1 and transferred allocation control of the chemical to Order M-300, the general chemicals order. This is in line with the WPB policy to place chemicals and allied products under a single order, the agency said. Schedule 60 (polyethylene) of M-300 raises the small-order exemption for experimental use from 5 to 25 pounds.

Orders M-18-b, M-203 and M-183 revoked

The War Production Board placed primary chromium chemicals, phthalate plasticizers and phosphate plasticizers under the control of M-300, the general chemicals order on Nov. 2. At the same time, M-18-b, M-203 and M-183, which formerly governed these chemicals, were revoked. This is in line with the WPB policy of placing all chemicals under a single order.

The entire output of phthalate plasticizers is now directed to the military. According to provisions of Schedule 63, of M-300, the small-order exemption for phthalate plasticizers has been reduced to 5 gal. of each type. Formerly, the small-order exemption was a total of 220 gal. monthly of the plasticizers. However, this is actually a paper change, incorporating into the schedule the provisions of a directive issued in March 1944, which reduced small order exemptions to this quantity.

Ethyl cellulose

Control of ethyl cellulose allocations was transferred to schedule 70 of General Chemicals Order M-300 on November 22. There are no appreciable changes involved in the transfer, and all details remain the same. It is presumed that the change was made to enable WPB to take advantage of paragraph (f) of M-300 if ethyl cellulose becomes available for increased civilian uses.

Acetate order amended

Molders no longer are required to file customers' Form WPB 2945 to obtain cellulose acetate and cellulose acetate butyrate molding powder, but merely need file certified statements of proposed end use with their suppliers, WPB announced today. Suppliers will file Form WPB 2947 on the basis of molders' certifications, instead of the previous Form WPB-2946. This action was taken by amending Schedule 52 to Chemicals Allocation Order M-300.

WPB now requires suppliers of these plastics materials to list only their customers with military orders, together with the end uses, and to ask for an aggregate quantity of materials for civilian distribution pursuant to Paragraph (f) of Order M-300.

It has been suggested that contract numbers be made plainly visible on all direct war use orders mailed to suppliers or they may be treated as civilian requests by suppliers and WPB. Goods sold to Army PX or Navy Stores are considered civilian goods by WPB and will not be given preferential treatment accorded military orders.

NEWS OF THE INDUSTRY

★ FELIX N. WILLIAMS, GENERAL manager of the Plastics Div., Monsanto Chemical Co., Springfield, Mass., has been elected a vice-president of the company.

An entirely new field has been opened to the plastics fabricator through the development of a new synthetic resin, perfected recently by Monsanto Chemical Co., St. Louis, Mo. The company claims that when this material is used properly in a low-pressure lamination process, size as a restrictive factor in forming plastics will be almost entirely eliminated. Prospective uses include curved wall panels, trailer bodies, boats and vermin-free chests. The present output of this resin is limited to military applications.

★ THE FOLLOWING APPOINTments and additions to the staff of Bakelite Corp., unit of Union Carbide and Carbon Corp., New York, N. Y., have been announced: Robert Clark Hill has joined the Research and Development Laboratories, Bloomfield, N. J.; J. E. Brister will be manager of Vinylite Wire and Cable Compounds Div.; J. Roy Price, becomes division manager of Vinylite plastics film and sheeting for consumer goods; C. W. Patton is now manager of Vinylite Coating and Adhesive Materials Div. of the Thermoplastics Dept.; Gilbert Shaw will manage Vinylite Calendering and Molding Materials Div., Thermoplastics Dept.; T. W. Sharp assumes management of Sheet and Foil Div., Thermoplastics Dept.; J. L. Rodgers will be manager of Bakelite Resin Glues Div.; and Eugene Williamson has been appointed manager of Printing Materials Division.

★ VELOFLEX, A NEW LEATHERlike plastic which is produced by Firestone Tire and Rubber Co., Akron, Ohio, is said to have great resistance to abrasion and scuffing. Tensile strength of the material is from 2000 to 4000 p.s.i., Other characteristics include acid, alkali and organic solvent resistance and moisture-proofness. Veloflex can be produced in various weights and thicknesses and in any shade. Its field of uses includes luggage, upholstery, purses, desk tops, gloves, clothing, seat covers and many other products formerly made of leather.

★ THE PLASTIC FORMULATING Council, an organization dealing in formulas for thermosetting and thermoplastic resins and paint, varnish and lacquer resins, has been organized by Bart Batty, former technical representative for Hercules Powder Co. The council is located at 2-255 General Motors Bldg., Detroit, Michigan.

★ CATALIN CORP., NEW YORK, N. Y., announces the appointment of Clinton Rector as general sales manager. Mr. Rector has been chief of the Plastics Branch, Chemicals Bureau, War Production Board since January of last year. At the same time, Jack Weiss, who has been associated with the company for 13 yr., was made sales manager of the Specialties Division.

★ A NYLON, WHICH CAN BE EXtruded in standard equipment at temperatures attainable by present commercial wire coating processes, has been announced by E. I. du Pont de Nemours and Co., Inc., Wilmington, Del. This new nylon plastic compound is said to permit coating of electrical wire at rates of more than 1000 ft. per minute. Tests show that nylon jackets 7 mils in thickness have been extruded on a machine having a 2-in. screw.

★ LYLE M. GEIGER HAS BEEN appointed to the position of director of research at Neville Co., Pittsburgh, Pa. During Mr. Geiger's long association with the company he has contributed to their work in synthetic resins, solvents and oils, broadening the application of the Nevillac resins and plasticizing oils.

★ E. R. BRODOON HAS BEEN APpointed plant manager of Molded Plastics Div., Continental Can Co., Cambridge, Ohio. Previous to this appointment Mr. Brodoon was assistant works manager of Balcrank, Inc., and general manager of B-G Automotive Mfg. Co.

★ THE SALES STAFF OF CELANESE Plastics Corp., New York, N. Y., has been augmented by the appointment of Jack Braden, formerly chemical and production engineer with Dayton Mfg. Co., Dayton, Ohio.

★ AMERICAN RESINOUS CHEMIcals Corp., Peabody, Mass., announces the opening of a new pilot plant and additional research laboratories for further investigation of monomer polymerization to produce new resins, and to coordinate developments in synthetics for paint, plastics, paper, textiles, leather and specialty rubbers.

★ THE GLUE DEPT. OF SWIFT & Company, Chicago, Ill., has announced two new fast-set synthetic resin adhesives for padding and other operations which require a fast-setting, flexible, cold adhesive. The resins are made from a polyvinyl acetate emulsion and come in a ready-to-use consistency for hand brushing and are applied cold. It has great tensile strength on a "straight" pull, but lets go readily when pulled at an angle.

★ FINISHED PLASTIC PRODUCTS of any size or shape may be colored permanently by means of a new dye announced by Wilmington Chemical Corp., New York, N. Y. Marketed under the name Poly-tint, the dye is used just as it is removed from the container. The product is colored by immersing it in the dye until the desired shade is obtained, removing it and rinsing in clear cold water.

★ GERALD J. LEUCK HAS BEEN appointed director of research of Glyco Products Co., Inc., Brooklyn, N. Y. Mr. Leuck will form a new research and development laboratory, staffed by chemists experienced in the paper, leather, textile, rubber, paint and plastics industries.

★ A NEW ORGANIC PEROXIDE—acetyl benzoyl peroxide—has been developed by Lucidol Corp., Buffalo, N. Y. The material has a higher active oxygen content than any other diacyl peroxide now used and is available in a pure, undiluted form.

★ THE OFFICE OF BEN NASH, CONsultant in product and market research has been moved to 15 Gramercy Park, New York, N. Y.

★ FOR THE PURPOSE OF DISTRIButing and trading in plastics of all kinds, A. H. Siegal, W. I. Siegal and D. G. Kingsley have incorporated The Royal Plastics Corp. of America, Chicago, Ill.

Sorryl

★ IN THE SEPTEMBER 1944 ISSUE of MODERN PLASTICS, there was illustrated on page 129, a plastic manicure box, having re-use value as a sewing box. Jean Reinecke of Barnes & Reinecke was credited with the box design. We desire to make the following correction: Jean Reinecke of Barnes & Reinecke designed the cover for the box in question. The box was originally designed by Frances Summon, formerly of the art staff of MODERN PLASTICS, and Fred B. Stanley, Engineering Editor of this magazine.

★ IN THE ARTICLE "A MULTIpurpose molding machine," the caption for Fig. 17, page 139, should have read "Tubing 15 in. in diameter with a wall thickness of $^{1}/_{4}$ in. has been produced experimentally for launching tubes."

Effect of environment

(*Continued from page 150*) dissolved and precipitated. Molecular weight was calculated by the equation:

$$MKc = \ln \eta_r$$

where M = weight average molecular weight
K = Staudinger's constant
$K = 10.25 \times 10^{-4}$ for cellulose acetate
$K = 11.00 \times 10^{-4}$ for cellulose nitrate
c = concentration, unit mols. per liter
η_r = relative viscosity

Figure 17 shows the effect of Florida exposure on the molecular weight of cellulose acetate and cellulose nitrate sheet plastics. These data are summarized in Table VII.

Discussion of results

The effects of temperature, humidity and testing speed on the mechanical properties of cellulose acetate and cellulose nitrate sheet plastics have been pointed out previously by Lawton, Carswell and Nason (2). The data presented herein show the effect of some environmental conditions on the permanence of these two plastic materials.

Cellulose acetate is moderately resistant to outdoor aging, whereas cellulose nitrate tends to degrade and lose its properties rather rapidly. Cellulose acetate is more sensitive to moisture than cellulose nitrate, whereas the effect of temperature is about the same for both.

Tensile strength, elongation and yield stress for both cellulose acetate and cellulose nitrate decrease with increasing outdoor exposure time, until the material eventually degrades so badly that mechanical properties cannot be measured. The modulus of elasticity increases with increasing exposure time as long as the material remains sufficiently coherent to be tested.

Approximately three times as long is required to degrade cellulose acetate as is required for cellulose nitrate. The degradation of cellulose nitrate appears to start soon after exposure, whereas in cellulose acetate a more gradual change is noted.

Two months of outdoor exposure is a more severe test for cellulose nitrate than two weeks at 50° C. or 48 hr. under an S-1 sunlamp.

The impact strength for both cellulose acetate and nitrate decreases with increasing exposure, whereas haze, light transmission and shrinkage increase. The increase in light transmission is thought to be due to a bleaching action.

Exposure in Miami, Fla., is more severe than at Springfield, Mass. To obtain the same effect as one year's exposure in Florida, approximately 15 months' exposure in Massachusetts is required. This ratio appears to be the same for both cellulose acetate and cellulose nitrate sheet plastic.

The degradation from outdoor exposure can be measured by change in viscosity. Viscosity measurements showed that, for both cellulose acetate and cellulose nitrate sheet plastic, most of the degradation was on the surface. As the exposure time increases, the degradation penetrates deeper into the sheet. Cellulose nitrate shows a much greater decrease in molecular weight than does cellulose acetate for the same exposure time.

After 12 months in Florida, the celullose acetate plastic sheet lost approximately 20 percent of its plasticizer, whereas the cellulose nitrate sheet lost 33 percent plasticizer after six months' exposure in Florida. Since the center of the plastic sheets appeared to be unchanged, undoubtedly the plasticizer was lost from the surface of the sheets.

TABLE VII.—EFFECT OF FLORIDA EXPOSURE ON THE MOLECULAR WEIGHT OF CELLULOSE ACETATE AND CELLULOSE NITRATE

Exposure time	*Molecular weight, whole plastic*	*Molecular weight, surface of plastic*
months		
	CELLULOSE ACETATE	
Original	48,100	48,100
3	47,300	44,600
6	46,600	43,100
9	46,100	37,500
12	45,200	35,200
	CELLULOSE NITRATE	
Original	42,100	42,100
1	38,200	16,800
2	35,100	7,400
3	31,900	5,100
4	28,900	4,400
5	26,600	4,100
6	25,400	3,500

Water immersion tests showed that cellulose nitrate is more resistant to moisture than cellulose acetate. On continual immersion, both materials appear to approach equilibrium.

The data given in this report are for typical production materials and are known to be representative. Since they are based on a limited number of tests and on only a few samples of materials, they should not be regarded as minimum values for design or specification purposes. A much larger number of tests should be made and evaluated statistically before any such values are set up.

Acknowledgment

We are indebted to Mr. J. H. Watt and Miss Dorothy L. Woodruff for assistance with much of the test work, to Mr. M. Ziemba for handling the outdoor exposure samples, and to Dr. C. K. Bump. The interest and encouragement of Mr. T. S. Carswell is gratefully acknowledged.

Bibliography

1. "Effect of Environmental Conditions on Mechanical Properties of Organic Plastics," by T. S. Carswell and H. K. Nason, American Society for Testing Materials Symposium on Plastics, Philadelphia: pp. 22–45 (Feb. 22, 1944); MODERN PLASTICS *21*, 121–6, 158, 160 (June 1944) and 125–30, 160, 162 (July 1944).

2. "Effect of Environmental Conditions on Mechanical Properties of Cellulose Acetate and Cellulose Nitrate Plastic Sheets," by T. S. Lawton, Jr., T. S. Carswell and H. K. Nason, MODERN PLASTICS *22*, 145–52, 188 (Oct. 1944).

3. "1943 Plastics Catalog," pp. 290–1, New York: Plastics Catalogue Corp.

4. "Handbook of Plastics," by H. R. Simonds, C. Ellis and M. H. Bigelow, pp. 510–13, New York: D. Van Nostrand Co. (1943).

5. Air Corps Specification No. 12025-B, "Plastic, Sheet, Cellulose Acetate Base," issued Nov. 19, 1940, amended Sept. 27, 1943.

6. Navy Aeronautical Specification P-41c, "Plastic, Transparent, Flame-Resisting Sheet," Feb. 22, 1943.

7. "Tentative Specifications for Cellulose Acetate Plastic Sheets," A.S.T.M. D 786-44 T, 1944 Book of A.S.T.M. Standards, Part III, Philadelphia: American Society for Testing Materials.

8. "Mechanical Tests of Cellulose Acetate," by W. N. Findley, Proc. A.S.T.M. *41*, 1231–45 (1941); MODERN PLASTICS *19*, 57–62, 78 (Sept. 1941).

9. "Mechanical Tests of Cellulose Acetate. Part II on Creep," by W. N. Findley, Proc. A.S.T.M. *42*, 914–22 (1942); MODERN PLASTICS *19*, 71–3, 114 (Aug. 1942).

10. "Mechanical Tests of Cellulose Acetate," by W. N. Findley, Trans. A.S.M.E. *65*, 479–97 (1943); MODERN PLASTICS *20*, 99–105, 138 (Mar. 1943).

11. "Tentative Specifications for Cellulose Nitrate (Pyroxylin) Plastic Sheets, Rods and Tubes," A.S.T.M. D 701-44 T, 1944 Book of A.S.T.M. Standards, Part III.

12. U. S. Army Specification 94-12008B, "Plastic Sheet Cellulose Nitrate Base," Dec. 28, 1940.

(*Please turn to next page*)

Tack

New..Pressure Sensitive CORDO-BOND Adhesives

IN contrast to the standard CORDO-BOND Adhesives which provide permanent, high strength bonds . . . adhesives of this new, pressure sensitive type provide a *permanently tacky bond.*

These new adhesives are tacky and are derived from a blend of plastics. Highly tenacious, exhibiting strong "legs" instant grab and powerful cling, they adhere to any dry surface. Availability runs from very soft tack to heat sealing.

So—CORDO-BOND Adhesives can help solve more of your present or post-war problems in bonding *metals, plastics, wood, glass, paper, cloth, leather, etc.*

Write, giving full details for exact analysis.

CORDO CHEMICAL CORPORATION
34 Smith St., Norwalk, Conn.
INDUSTRIAL COATINGS • FINISHES
INDUSTRIAL ADHESIVES

CORDO-BOND

13. Federal Specification GG-T-671, "Triangles, Pyroxylin," Sept. 4, 1934.
14. "Tentative Method of Test for Colorfastness of Plastics to Light," A.S.T.M. D 620-41 T, 1942 Book of A.S.T.M. Standards, Part III, pp. 1223-5.
15. "Tentative Method of Test for Tensile Properties of Plastics," A.S.T.M. D 638-44 T, 1944 Book of A.S.T.M. Standards, Part III.
16. Federal Specification L-P-406a, "Plastics, Organic, General Specifications, Test Methods," January 24, 1944, Government Printing Office, Washington, D. C. (15 cents).
17. "Tentative Methods of Test for Impact Resistance of Plastics and Electrical Insulating Materials," A.S.T.M. D 256-43 T, A.S.T.M. Standards, 1943 Supplement, Part III, pp. 249-54.
18. "Tentative Method of Test for Haze of Transparent Plastics by Photoelectric Cell," A.S.T.M. D 672-42 T, 1942 Book of A.S.T.M. Standards, Part III, pp. 1260-2.
19. "Tentative Method of Test for Mar Resistance of Plastics," A.S.T.M. D 673-42 T, 1942 Book of A.S.T.M. Standards, Part III, pp. 1263-7.
20. "Standard Method of Test for Water Absorption of Plastics," A.S.T.M. D 570-42, 1942 Book of A.S.T.M. Standards, Part III, pp. 400-2.
21. "Tentative Descriptive Nomenclature for Objects Made from Plastics," A.S.T.M. D 675-43 T, A.S.T.M. Standards, 1943 Supplement, Part III, pp. 364-8.

First aid for surgery

(Continued from page 119)

Parallel with the successful development of the liquid adhesive were the experiments conducted with the possibility of finding a suitable composition—consisting basically of the same resin and plasticizer—which could be produced as a solid sheet of film. This film was not to be used as a supplement to the gauze bandages or adhesives but to replace them entirely wherever feasible.

The same process of testing and checking was followed as in the case of the liquid, until a satisfactory balance between resin and plasticizer was obtained. Before acceptance, however, the film was also tested on adhesive sensitive patients. Of a total of 146 patients tested, the incidence of sensitivity recorded was 3½ percent.

Four types of film were evolved, each with its own particular properties suitable to specialized applications. Characteristics peculiar to all, however, were those of self adherence upon application of pressures at normal body temperatures and the possibility of reuse, with full elasticity, after sterilization in water heated for twenty minutes to temperatures as high as 220°.

The manufacturing procedures for the films consist of the mixing of the chemicals in a large container or vat and calendering them in long strips about 36 in. wide. After the film sets it is rolled for convenience in handling, cut to suitable widths, and further processed or left untreated depending on its ultimate use.

Type I is first sent to be specially perforated before it is released. This process enables it to be used in applications where a firm pressure bandage is required without the complete elimination of air from the injured part. Surgical applications include pressure bandages for certain types of burns, bandaging in the case of sprains and strapping in the control of varicose veins.

The second type, which is left unperforated, is used principally to replace Esmark bandages in the case of operations.

An unperforated film—Type III—is used in skin grafting, a use which makes it possible to keep grafted skin without curling of the edges. This tendency of curling had previously hindered doctors in the utilization of the entire area of skin removed. In such applications, the film is coated on both sides with rubber cement and mounted on a dermatone[3] which has also been coated with rubber cement. After the film has adhered to the dermatone, the apparatus is applied to that portion of the anatomy from which the skin is to be grafted. The section of skin to be grafted has already been delineated and rubber cement applied to the area. The cut skin adheres to the surface of the film and both are removed. If the grafted skin is to be cut in small pieces for covering large areas, the film facilitates easy handling and cutting.

A fourth film, also unperforated, is glued over the mouth, eyes or infected areas to prevent contamination of clean surgical incisions in the same region, thus effecting a complete isolation of the operative field. Common to every type of film is the fact that it can be sterilized the same as the more porous towels and sheeting normally used.

An additional use of the liquid suggested by the experiments of a doctor working with an entirely different plastic solution is that of coating the operative field of the skin with the liquid adhesive after application of antiseptics to prevent the possibility of infection from bacteria aroused by perspiration of the body. The perspiration problem during surgery is one of the uncontrollable factors that account for many infections. Dr. Michael de Bakey, in the archives of gynecology and obstetrics, wrote about his experiences with solutions of resins that reduced infections caused by bacteria carried out by the perspiration.

All of the applications suggested for the films are at present limited to the needs of hospitals and doctors, since the supply of materials is short and the requirements of suffering humanity naturally come first. However, many industrial uses are contemplated for them as soon as the plastic is available.

Acknowledgment

Modern Plastics wishes to acknowledge the assistance of Mr. David Rosenberg, inventor of the liquid adhesives, and of Gordon-Lacey Products Co., in the preparation of this article. Acknowledgment is also extended to the staffs of Montefiore Hospital, N. Y., and Montefiore County Sanatorium, who cooperated in testing various materials, particularly as to their possible irritating action on the skin.

[3] Invented by Dr. Padgett, Kansas City, the dermatone consists of a half cylinder with a swivel-type blade which can cut skin to any required depth.

New forming technique

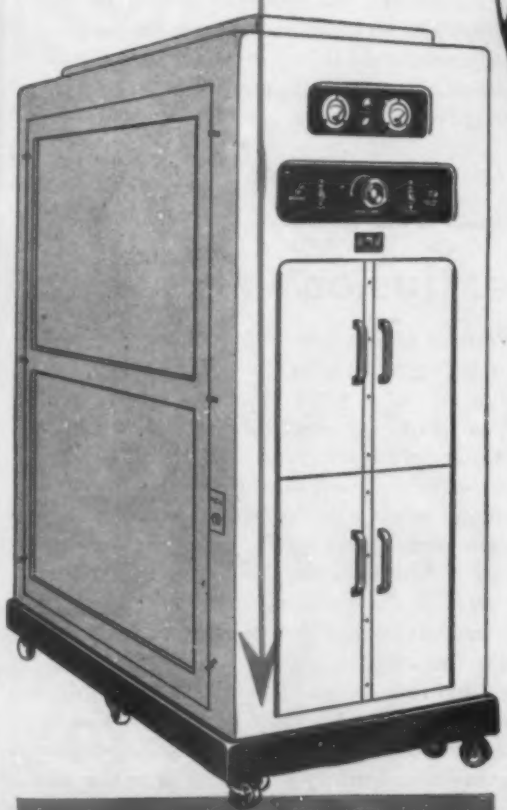
(Continued from page 122) the joint, the edges of the acrylic resin were quickly closed under full pressure, the confining strips being pulled tighter around the frustrum. This method produces a welded joint that is strong and only slightly distorted, needing very little scraping and polishing in the final finishing.

To weld a cap on this frustrum so that the material in the two parts form a continuous section, the cap must be shaped with turned up edges that abut exactly on the end of the frustrum. This was accomplished by laying a hot piece of acrylic resin sheet over a hole cut to the size required for the outside diameter of the cap and using a plug shaped to the inner diameter of the end cap to force the plastic into the hole (Fig. 2). The operation is comparable to that employed with embroidery hoops.

The next operation was the jointing of the edges of both the cap and the frustrum so that they could be brought together in an exact fit. The best procedure was to make the end of the frustrum a little too small. Then, by trimming off the end until its diameter matched that of the cap, an almost perfect joint was achieved.

However, before the welding could be effected, a heating strip had to be fashioned in the shape of two semicircles with

There's no ONE-MAN-BAND in Electronic Heating



Although it is possible to construct an electronic heater that will generate a great range of high frequency currents, it will not perform *all* heating jobs efficiently and it would be very costly in use.

Virtually every application of electronic heating requires a specific FREQUENCY AND POWER combination. Therefore, to realize the maximum advantages of this improved heating method, *each installation should be designed and built for its particular application.* For example: when a heating operation can best be done at 5 kw and 22 megacycles it would be *wasteful* and *inefficient* to use a machine that delivers 20 kw at 500 kc.

Many first-time users of electronic heating are induced to buy "misfits" when they try to find an all-purpose machine. Our extensive line of equipment offers you the broadest range of power and frequency combinations at *prices lower* than other makes of comparable quality.

Investigate the production economies and advanced engineering designs offered by our greater variety of units . . . each one time-tested for high efficiency.

Before you buy write to us for detailed information

Our equipment offers you a selection of frequencies up to 300 megacycles — and the following power range, with stepless control from zero to full load:

3 Kw
5 Kw
7½ Kw
10 Kw
12½ Kw
15 Kw
18 Kw
25 Kw
40 Kw
100 Kw

Scientific Electric

DIVISION OF "S" CORRUGATED QUENCHED GAP COMPANY
119 Monroe Street Garfield, New Jersey

Manufacturers of Vacuum Tube and Spark Gap Converters since 1921

projecting tabs. When joined together these two strips formed a circle a little larger in diameter than the acrylic resin part, thus allowing for heat expansion. After the tabs had been located one above the other, they were clipped to the transformer wires (Fig. 3).

A 2-piece transite disk was made to the same diameter as the interior of the cap and its edges grooved to accommodate the edge of the heater. It was the use of this block that prevented inward distortion of the material. To circumvent outward distortion, two strips of acrylic resin were formed around the edges of cap and frustrum. Since the edges of the cap were under compression as a result of being turned up, the heat of the welding blade would have caused them to fall outward if it had not been for this restricting band. At this point the form was set cap down on a solid disk of wood and another block laid across the open end of the cylinder. Additional pressure to close the joint was assured by carpenter's clamps applied between the two pieces of wood.

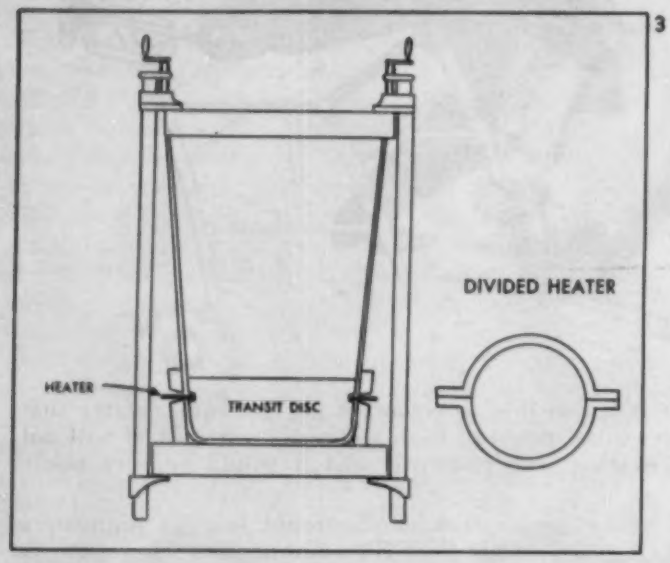
Current was then turned on and the joint between cap and frustrum heated until the edges of both parts were smoking. The electricity was immediately stopped, but the blade was again left to cool in the joint until the acrylic resin edges were in a liquid condition. Then the heating strip was removed and pressure applied to the joint until cold. Both joints were scraped, sanded and polished to give the outer surfaces of the form a smooth and unbroken appearance.

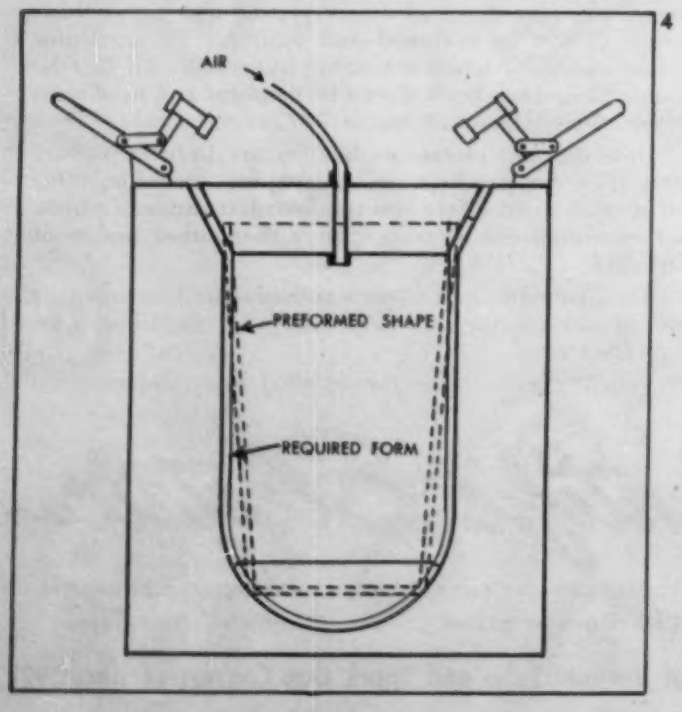
At this point the entire assembly was heated to forming temperature and pushed into a female mold of the requisite shape but enough oversize to allow for the contraction of the material as it cooled. A circular wooden plug was clamped over the mouth of the form, and air allowed to enter the transparent capped cylinder under pressure to force the acrylic resin "preform" to the contours of the mold. When cold, the part was trimmed to length, sanded and polished.

When one form made by this process was cut open for examination, the thickness variation was found to be very slight—even at the joint. Since the turned up edge of the original cap was compressed, not stretched, the excess material present at the joint seems to have prevented too great thinning in the adjacent areas. This same method of fabrication can also be employed for blown-out bottle forms, for boxes with molded edges.

Credit—Material: Plexiglas.

***3**—Before the edges of the cap and frustrum could be welded, a heating strip was fashioned in the shape of 2 semicircles. The tabs on these strips are clamped to the transformer wires. **4**—In a final operation, the entire assembly is heated and pushed into a female mold of the requisite shape. Air is allowed to enter the transparent capped cylinder under pressure to force the acrylic resin "preform" to the contours of the mold*





Screw extrusion

(*Continued from page 135*) a needle pyrometer the stock is usually 50 to 60 degrees higher than the surface temperature of the mill.

The thickness of blanket or sheet being milled should be about $^1/_4$ to $^1/_2$ in. and a small bank should be used. Strips cut from thinner blankets chill too readily—a circumstance that results in rough lumps. To insure a smooth sheet on the mill at all times and to keep a sufficient amount of compound on the mill to accommodate the extrusion rate, it is often necessary to have a second mill to pretreat the compound. This second mill insures that only thoroughly worked compound is fed to the primary mill and on to the extruder.

When milling vinyl resin compounds that are stiffer than those previously mentioned, care must be exercised that the thermal treatment on long-time milling will not be so great as to cause excessive temperatures to develop at the secondary bank. To relieve this condition, the blanket which is being warmed up can be cut from the mill periodically to reduce the stock temperature. When only one mill is used for the complete preworking of the stock, cooling can be readily accomplished through the use of a separator placed approximately in the center of the mill. This arrangement permits half of the mill to be used for keeping thoroughly worked compound ready for feeding to the tuber, and the other half for preliminary treatment of the stock. Use of a two-roll mill to preheat compounds for plastic tubers or converted rubber tubers generally permits lower temperature conditions to be maintained in the extruders than is the case when room-temperature materials are used. (*Please turn to next page*)

They'll want lighter, brighter colors in tomorrow's products

VELON*

makes any color practical where it never was before

Never again be satisfied with dull, drab colors. For with Firestone's new wonder material, *Velon,* any color is practical, *anywhere!*

It comes back new-clean and bright every time at the merest wipe with a damp cloth or cleaning fluid. Dust can't cling to *Velon.* Grease won't hold. Water won't absorb. It resists both acids and alkalis. It's safe, non-inflammable.

And it's all but everlasting! *Velon* is so durable that after more than three years of the toughest abuse, as the upholstery fabric of thousands of car, bus, train, plane and cab seats, it has yet to show the slightest sign of wear—or to lose any of its original, colorful, bright new beauty . . .

You just can't afford to pass up the limitless possibilities of this amazing, wholly new kind of material—that can be made to your specifications in any conceivable color and in an infinite variety of weaves and patterns.

Right now, of course, all the *Velon* Firestone can make goes to the armed forces. But keep *Velon's* extreme versatility in mind in *all* your plans for postwar products.

LISTEN TO THE VOICE OF FIRESTONE
MONDAY EVENINGS OVER NBC.

ANOTHER CONTRIBUTION TO A BETTER WAY OF LIFE by **Firestone**

*Trademark – Pronounced VEL-LON

In order to obtain maximum extrusion speeds, it is desirable that a temperature gradient be maintained throughout the machine along with a worm speed that will give satisfactory delivery of the compound and proper head pressures. The temperature gradient and worm speed vary for different amounts of compound being extruded. With higher worm speeds it is very important that sufficient cooling water be passed through the core of the worm to eliminate any possibility of thermal breakdown of the compound. With each set of conditions, the amount of cooling water introduced in the core of the worm should be adjusted to give the proper plastic flow of the compound. A temperature indicating device should be standard equipment so that the water exit temperature can be checked and the temperature controlled.

Figure 2 illustrates typical temperatures of the head, die and breaker plate sections, the proper screens to use, and the worm speed for various size insulated wires when using a plastic extruder with a worm $3^1/_4$ in. in diameter and $28^1/_2$ in. long. The running conditions for a 0.030-in. wall of VE 5906 are shown in Fig. 2 by broken lines, indicated as *A*, *B*, *C* and *D*.

A to *B*—screen setup (mesh)
A to *C*—surface temperature of die, head and collar
A to *D*—r.p.m. of the worm

When extruding heavy walls of primary insulation, or jacketing with a plastic extruder having a worm, 6 in. in diameter by 47 in. long, and employing a breaker plate, it is the general practice to use only one 12-mesh screen. The barrel extension should be set approximately 30° F. and the feed section 60° F. lower than the values listed in Fig. 2. It also holds true that the capacity of the machine can be increased for a given wire size by increasing the worm speed and by decreasing the tuber temperatures. However, too great an increase in wire speed results in increased spark failures.

Figure 5 illustrates the effect of worm speed under set temperature conditions on the capacity of the extrusion machine. These data are helpful in evaluating the tubing efficiency of various compounds and in determining the proper worm speed for a given job. When using plastic extruders, without breaker plates or screens, which have a worm diameter of about $3^1/_4$ in. and a length of about 39 in.—including a 4-in. cone on the end of the worm—high temperatures in the head, die and barrel are generally used together with high worm speeds (30 to 60 r.p.m.) in order to create the proper plastic flow.

The many variations in design of extruders now in use make it impractical to lay down hard and fast rules which must be followed in all cases. The foregoing information covers the more general factors, and it is believed that the technician can adapt these facts to his individual problems.

New field for melamine

(*Continued from page 107*) other words untreated cloth which will stretch only so far over a mold without breaking the fibers will stretch only that same distance after it has been impregnated with melamine varnish.

Although first experiments in the use of melamine varnish to impregnate materials for low-pressure laminating was undertaken with a view to the widespread use of the resulting sections in the automotive industry, it now appears that the immediate use of the material will be in the field of furniture manufacture—particularly children's furniture. Through the use of melamine-treated material it is possible to reproduce Mother Goose, Donald Duck and other juvenile favorites on a washable, wear-resistant surface. Low-pressure panels can also be used in children's high chairs, headboards and table tops.

But children's furniture is by no means the only field open to a laminated material having a hard alkali-resistant surface. Liquor resistant trays, table tops, game boards, radio panels—all are possible items of manufacture. Principally because most of the experimental work has been carried on in the manufacture of sheets or panels, the greatest progress in lamination has been in the production of a section or block where an intricate or involved design is of as great importance as the quality of the surface itself.

One of the most interesting possibilities for the melamine-impregnated fabric laminates is in the creation of an entirely new line of luggage and instrument cases. It is possible to manufacture a whole line of luggage—suitcases, travelling bags and overnight kits—which are light and have a scar-proof moisture-proof surface finish in the same wide range of color which makes possible accurate reproductions of figured prints. Specialized decorative designs can also be incorporated in these cases.

Another application would seem to be in the field of cases for scientific and engineering instruments, particularly for those instruments which are destined for use under varying field conditions. A microscope case, which will not mildew in the tropics and will retain its shape for the life of the instrument it protects, is pretty close to the answer to a field scientist's prayer. Also, a theodolite case that can be subjected to the wear and tear of field usage is certainly something that would interest a surveyor. The advantages of a material which can be laminated at low pressure are also apparent in the field of airplane manufacture—particularly cargo planes.

But there are uses for these low-pressure laminates much closer to home. Imagine having a portable typewriter cover that would literally outlast the typewriter itself. Imagine a case for a musical instrument that would last a lifetime, maintaining its sleek appearance as long as it was in use. Because of low heat conductivity and resistance to ordinary temperatures, low-pressure melamine-coated material seems almost ideally suited for application to such items as iron rests and table decorations.

Another possible field for development is in the manufacture of weather-proof signs, street markers, directional warnings and similar objects where the use of low-pressure technique particularly recommends itself due to the fact that the manufacture of most of the applications is almost on a custom basis. Street markers, which conform to the all-over architectural motif of a highly restricted subdivision, seem to offer a field for experiment—particularly in the use of the silk screen technique for surface decoration.

One factor which has slowed down the use of this material in laminated sections for automobiles is the fact that price comparisons are particularly difficult. And price comparisons are of singular importance in automotive design and will remain a determining factor in the postwar car.

One school of automotive designers holds that metal, having a lower raw material cost and possessing certain manufacturing advantages, is preferable to plastics or plastic-bonded materials. Plastics manufacturers, on the other hand point out that in metal panels several preliminary operations are necessary before a low-cost metal stamping can be installed in the completed car. After the original stock—manufactured to specification—is stamped, the stamping must

be degreased, rust-proofed, primed and finished. These operations involve a lagging time schedule but are necessary before the stamped part is ready to be incorporated into the body of the completed automobile.

To support their argument for laminated panels, plastics men present the argument that with low-pressure operation it is possible to produce, in a single operation, a hard-surfaced panel complete with identifying and directional markings, ready for final assembly installation. It is their contention that the resultant saving in handling time offsets the apparent discrepancy between the low raw material costs of metal and impregnated plies.

In this connection, the most obvious application of melamine-surfaced sections laminated by low-pressure would be on the dash board of an automobile where the conventional operational dials could easily be included in the surface layer. And if it were found either necessary or desirable to have the instrument panel harmonize with the interior finish of the car, use of a colored underlay would easily meet the requirement. To strengthen the case of the plastics manufacturers, engineers admit that melamine-surface panels have a corrosion resistance greatly in excess of any painted metal.

In the handling of laminated materials the question of machining is always important. Tests on the hard marble-like surface of low-pressure laminates produced with a surface ply of melamine impregnated fabric have shown that machining is not difficult, only different, as is the case with many plastics. However, standard operational procedures which generally obtain in the machining of plastics that have the properties of melamine moldings are satisfactory in this application.

Where it is necessary to saw panels to close dimensions, a saw with very little "set" and with a good clearance seems to give good results. A recently developed technique which employs a "wet wheel" promises to become standard procedure. One of the important factors in obtaining a clear, sharp cut is the rate and evenness with which the material is fed into the saw. When the feeding is uneven, the cut is raw and ragged and not too close to dimensional requirements. But when the feeding is even, there is a clear accurate cut. The roughened edges of a cut, will, however, respond to polishing.

Because of the hard, glass-like surface of the material, use of a center punch to give a fixed spot for the start of a drilling operation is advisable. Once the drill is set in the depression made by the center punch, drilling proceeds satisfactorily without surface shattering or deviation from dimensional requirements. When a center punch is not used, the drill tends to slip off center—causing improperly drilled holes and surface scars.

Though many of the manufacturing possibilities discussed in this article are more or less in the experimental stage, fabric impregnated with melamine varnish and capable of low-pressure lamination is being successfully employed in the manufacture of playing boards for table tennis. In this application a dark green fabric marked in white with the proper boundary lines is impregnated with melamine varnish and then cut to size and fitted on a plywood core. The whole section is then laminated at low pressure in a hot-press plywood machine with satisfactory results. Plywood may be produced in the same operation—the only disadvantage being a longer curing time than is normally required for plywood manufacture. The resulting product is a table top that is indelibly marked with boundary lines and which has a smooth, hard surface that will stand up even under the hardest wear.

WPB, Plastics Branch

(*Continued from page 104*) material monthly for specific end use products allocated since October 1, 1943. This was recently cut to 500 lb. due to formaldehyde shortage. M-246 was again amended May 8 to permit two drums of material for experimental purposes, and there is good prospect that it will soon be placed under M-300 to permit adoption of paragraph (f) for allocation of civilian goods, but the formaldehyde situation has intervened here as it has with urea, and at present civilian allocations are being cut in varying proportion according to essentiality.

Another important action taken during the last year was the amendment of M-154, the regulation forbidding manufacture of certain items from thermoplastic materials. All thermoplastics were eliminated except those made from nitrocellulose, which were continued because there is no other order controlling nitrate plastics. The regulation was revoked insofar as it pertained to everything but nitrate in order to save paperwork and because the materials were all controlled by other orders that limited end uses.

Perhaps as important as any one action, insofar as molders are concerned, was revocation of L-159, the machinery order, and the resultant placing of all new machinery allocation on a scheduling basis controlled by Table 15 of Order M-293. The result was abandonment of control over used machines and molds, although the latter still require a priority rating. Under the new system, manufacturers are told which machines to deliver first and the allocations are made by quarters. Ten injection machines were allocated for the third quarter and 57 for the fourth. About 70 are to be allocated for the first quarter of 1945. Extruders are in great demand and can only be granted for war purposes; it takes about 26 weeks to get one. Compression presses are in fair supply but still being allocated to plants where war work is heaviest.

The greatest worries for the Plastics Branch during 1944 have undoubtedly been in material shortages. There are 28 materials allocated by this Branch and about 20 of them have suffered in one way or another from lack of material. Among the most basic is benzol, which is needed for high octane gasoline and rubber, but is also an essential material for phenolics and polystyrene. There is scant hope that it will be plentiful until all the enemy are put out of action.

Formaldehyde was sufficient to meet most needs until October when it suddenly tightened up due to lack of a sufficient quantity of methanol. Some methanol plants were converted to ammonia which was needed for powder and fertilizer, and large quantities are also going to Lend-Lease. There is some prospect of partial relief, but not enough to take care of all civilian needs until after "V-E" Day.

Plasticizers have been in tight supply all year, starting with butyric acid last January. When that item became short, dimethyl and diethyl phthalates were frequently substituted for it in other chemical operations, and as a result they became short for use in plastics. These latter two, derived from phthalic anhydride, became more scarce as the need for phthalic anhydride increased due to military demands such as ammunition and DDT. Triacetin had no more than come into use as a substitute plasticizer than an increasingly large portion of it was diverted to an undisclosed military use. Furthermore, other scarce plasticizers had to be used with it when it was used with acetate. Suppliers are to be congratulated on their ability to find and use substitute plasticizers in order to maintain production levels.

Cresol was up and down during the last year due to the shipping situation and importation of British cresol. It

PLASTIC injection molded. Injection up to 18 oz. each. Industrial application.

METAL stampings drawn — formed — welded. Fabricated in areas up to 72" x 20".

Complete service

PLASTIC MOLDING
METAL STAMPING
PLASTIC *with* METAL

This unique three-way service, backed by years of experience, gives you the finest in Metal Fabricating and Plastic Molding. Our alert, experienced engineering and designing staff are abreast of today's rapid changes in material and production methods.

Our PLASTIC DIVISION furnished custom molding in all thermoplastics from a fraction of an ounce up to 18 ounces per shot. Our METAL DIVISION fabricates in all heavy and new light metals. Drawing, Coining, Stamping, Welding, Rolling, Forming.

THE METAL SPECIALTY CO

PLASTIC MOLDING
METAL STAMPING

ESTE AVE. • CINCINNATI 32 • OHIO

BRANCH PLANT — SOUTH L ST., RICHMOND, IND.
SALES OFFICE — W. GRAND BLVD., DETROIT, MICH.

recently showed improvement that may hold through 1945.

Phenolics were held down by benzol and formaldehyde. There should be plenty to meet all important demands after "V-E" Day, but control may continue because of other needs for benzol.

Urea and melamine were plentiful during most of year, but production was held down slightly due to manpower. The formaldehyde shortage forced curtailment in production.

Acetate and butyrate production was steady during year despite plasticizer, flake, cotton linter and recent acetic anhydride shortages.

Vinyls showed a tremendously increased production during the year. There were three increases in production facilities and more are scheduled for 1945. Besides this, there was a heavy demand for Lend-Lease. A serious shortage threatened in late spring when a new plant did not come in as soon as expected and vinyls had been pinch-hitting for a short Neoprene supply. Some varieties are now being made available in small quantities for civilian uses.

Polystyrene facilities are available for 1,000,000 lb. a month, but total production of molding powder is only about one-third of this amount because styrene is not available. A considerable quantity of polystyrene is also being produced for other purposes than molding powder.

Ethyl cellulose showed large increases in facilities during the year with more coming in 1945. A small amount has been free for civilian goods, but new military demands may take it all.

Acrylics have been in tight supply all year because of metallic sodium shortage. The latter is needed for military uses.

Cellulose nitrate is now in about 70 percent production compared with the first of the year. The decline is due to a synthetic camphor shortage caused by large Lend-Lease shipments. This material is scheduled to go on M-340, a regulation which eliminates all ratings except certified war orders which bear ratings.

NILS ANDERSON
CHIEF, PLASTICS BRANCH
CHEMICALS BUREAU, WPB

Advances in plastics

(*Continued from page 96*)

The textile and coated fabrics industries are employing more and more resins, both in kind and volume, in supplying the demands of the Army and Navy. Comprehensive surveys of technological developments in synthetic fibers[151–154] included rayon, nylon, vinyl, vinylidene, casein and glass types. Coated fabrics are employed in Quartermaster equipment for raincoats, mountain tents, hospital sheeting, upholstery, bedding bags and clothing interliners.[155–157] Fiber treatments with resins to improve water-proofness, crease-resistance, wearing qualities, dimensional stability, and handling properties are in a stage of development.[158]

Papers were published discussing the uses of plastics in the plating industry,[159, 160] shoes,[161] paper manufacture,[162] protective coatings,[163–165] transportation,[166–170] and physiotherapy.[171–173] Developments in pattern plates,[174] impregnation of castings,[175] cable insulation,[176] and brake linings[177] were described. Postwar applications of luminescent pigments[178] and of color in molded products[179, 180] were reviewed. A significant trend to informative labelling of plastic products was foretold, the background of this consumer-sponsored movement was outlined, and a plan for developing suitable labels for plastics was presented in an outstanding survey of this subject.[181]

Properties, testing, specifications

Many valuable data were contained in the papers sponsored by the Rubber and Plastics Division of the American Society of Mechanical Engineers. Three papers on plastics were presented at the semi-annual meeting in Pittsburgh in June; these pertained to dimensional stability of laminates,[182] strength properties of cellulose acetate and cellulose nitrate sheets,[183] and post-forming of laminates.[184] Three further papers were given at the annual meeting in New York in November; these concerned creep properties of phenolic plastics at elevated temperatures,[185] permanence properties of cellulose acetate and cellulose nitrate sheets,[186] and properties of high-strength paper-base laminates.[187] Other reports covered investigations of the resistance of phenolic and urea resinous adhesives in plywood to alternating stresses,[188, 189] strength properties of glass[190] and wood[191, 192] laminates and the fabrication and utilization of plywood.[193–197]

The highlight of the year technically was the symposium on plastics held under the auspices of the American Society for Testing Materials in Philadelphia in February.[198] Included in this publication are papers on the heat resistance of laminates,[199] effect of environmental conditions on the mechanical properties of plastics,[200] diffusion of water through plastics,[201] stiffness and brittleness of vinyl elastomers,[202] behavior of plastics under repeated stress,[203] testing of high strength plastics,[204] and creep characteristics of plastics.[205] Five technical reports on plastics were presented at the annual meeting of the Society in New York in June; these related to indentation hardness,[206] impact testing,[207] creep tests of paper-base laminate,[208] flow properties of phenolic laminates at elevated temperatures[209] as well as to fatigue tests on compreg.[210]

Important contributions were made to our knowledge of the creep,[211–213] shear,[214, 215] impact,[216] bearing,[217] flow,[218, 219] electrical,[220] optical[221] and thermal expansion[222, 223] properties of plastics. The water absorption and permeability to moisture of various materials were reported.[224–228] Gas permeability of plastic films was studied by two authors.[229, 230] Properties of plywood,[231] compreg,[232] phenolic laminates,[233, 234] and methacrylate sheets[235] were described. Other topics discussed in the literature included the relation between test data obtained on standard specimens and the properties of molded plastic parts,[236, 237] solubility of plasticizers in liquid ammonia[238] and iron exchange resins.[239]

Three noteworthy contributions were made to the identification of plastic materials.[240–242] A method for the determination of the plasticizer content of cellulose plastics was published.[243] Tests for measuring impact strength[244] and scattering of light by plastics[245] were described.

Committee D-20 on Plastics of the American Society for Testing Materials completed action on five test methods, three recommended practices, and four new specifications for plastics.[246] The testing procedures pertain to the measurement of flexural strength, indentation hardness, luminous reflectance and transmission characteristics and color, specific gravity, and stability of chlorine containing plastics. The recommended practices are for determination of the permanent effect of heat, accelerated weathering of plastics using the S-1 bulb and fog chamber, and molding impact specimens of general-purpose phenolic materials. The four specifications covered cellulose acetate sheets and ethyl cellulose, methacrylate and nylon molding compounds.

Standards for plastic fittings and tubing adopted by the National Aircraft Standards Committee were published.[247] Tolerances for laminated plastics[248] were discussed with em-

We're cooking up New Answers in Plastics

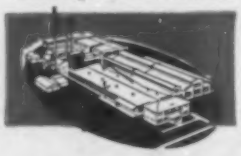
RADIO-FREQUENCY preheating is an important development in plastic molding. It makes new applications feasible and many better cures possible—and it can increase your daily production. It's something to look for when you select your plastics molder.

Look for this too. A full installation of preheating equipment is important — but complete equipment plus extended experience in its use means a whole lot more. The machines will suddenly be available to everyone after the war. The experience won't.

At Kurz-Kasch, we've been building up preheating technique since the *first* R.C.A. radio-frequency machine was delivered to us for experiment back in early 1943. We've got plenty of all kinds now, and we know how to design for them, estimate for them, and use them.

If you want this kind of progressive thinking in your molder—and want it backed up by a solid record of accomplishment dating back to the birth of the plastics industry — ask Kurz-Kasch to figure on your plastics application. Just ask for an engineer.

WHY KURZ-KASCH FOR PLASTICS? Kurz-Kasch offers a 28 year old reputation for thoroughly-engineered, quality production. • One of the largest, best-equipped exclusive custom molding plants in the country—75,000 sq. ft. of floor space with 125 compression and transfer presses of all sizes. • Complete mold-making and finishing facilities. • Extensive production sequences of radio-frequency preheating equipment, with full experience in their use. • Complete insert-production shop. • For satisfaction in plastics, key these facilities into your production line.



THE WAR BONDS YOU KEEP ARE THE BONDS THAT COUNT

Kurz-Kasch

For over 25 years Planners and Molders in Plastics

Kurz-Kasch, Inc., 1415 South Broadway, Dayton 1, Ohio. *Branch Sales Offices:* New York • Chicago • Detroit Indianapolis • Los Angeles • Dallas • St. Louis • Toronto, Canada. *Export Offices:* 89 Broad Street, New York City

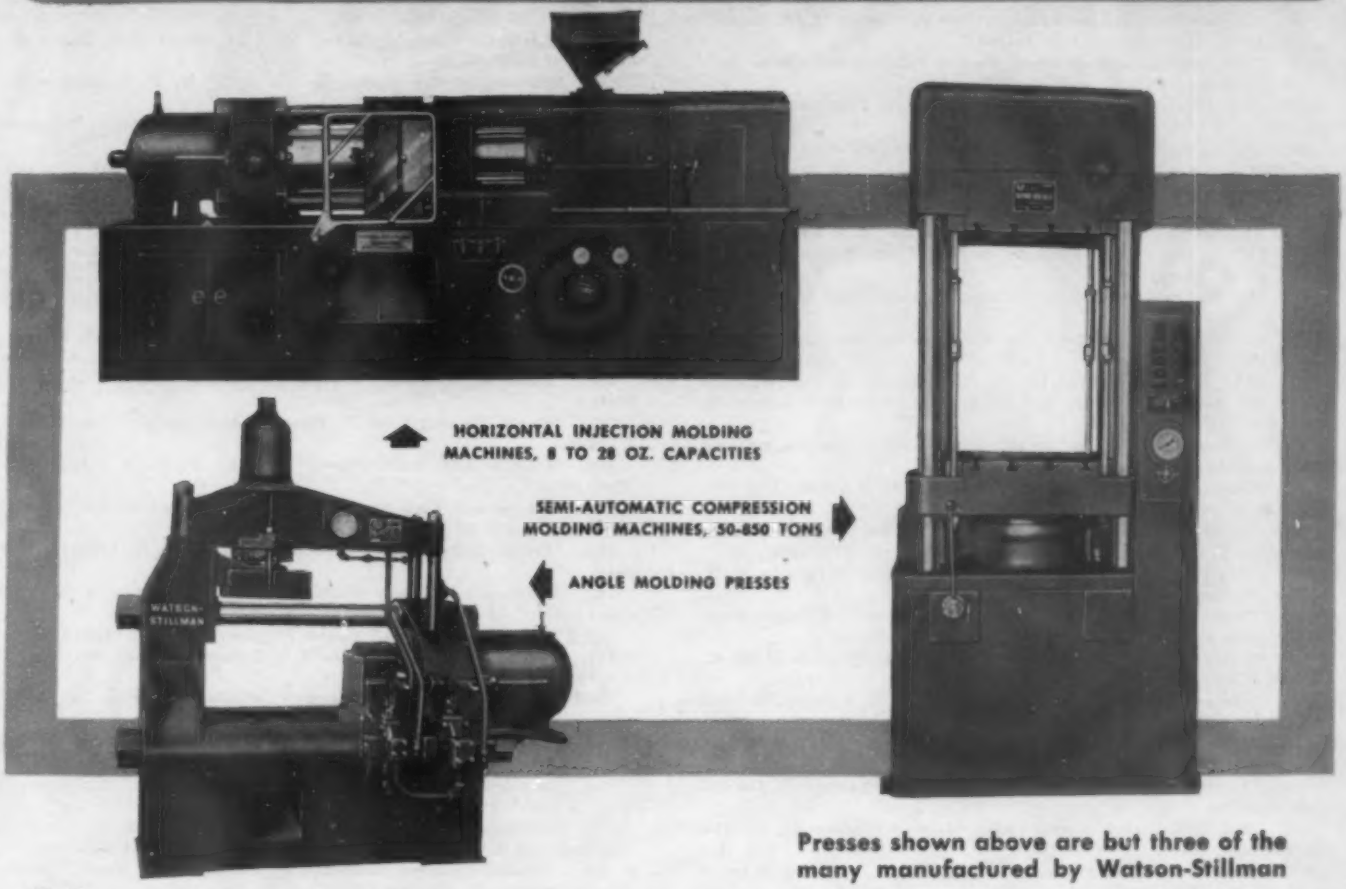
phasis on the specification of the maximum safe tolerance in order to expedite deliveries under wartime conditions.

The formation of A.S.T.M. Committee D-14 on Adhesives was announced during the year.[249] Subcommittees on strength properties, analytical tests, permanence properties, working qualities, specifications and nomenclature have been organized.

References

1. "Annual Fall SPI Conference," MODERN PLASTICS *22*, 117–132 (Dec. 1944).
2. "Production of Synthetic Resins in 1943," MODERN PLASTICS *22*, 116, 192 (Sept. 1944).
3. "Industry Expansion," MODERN PLASTICS *22*, 97–102, 202, 204 (Nov. 1944).
4. "Polyethylene—A New Thermoplastic," by J. W. Shackleton, MODERN PLASTICS *21*, 99, 178, 180 (Feb. 1944).
5. "Polymerized Ethylene—New Hydrocarbon Plastic," Chemical Industries *54*, 371 (Mar. 1944).
6. "Properties of Polyethylene Suggest Peacetime Applications," Product Eng. *15*, 202–203 (Mar. 1944).
7. "A New Dielectric for Cables," by H. C. Crafton, Jr., and H. B. Slade, MODERN PLASTICS *21*, 90–93, 168, 170 (July 1944).
8. "Polyethylene," by C. S. Myers, MODERN PLASTICS *21*, 103–107, 174, 176 (Aug. 1944).
9. "Silicones," Chem. and Eng. News *22*, 1134 (July 10, 1944).
10. "Silicones—High Polymeric Substances," by S. L. Bass, J. F. Hyde, E. C. Britton and R. R. McGregor, MODERN PLASTICS *22*, 124–126 (Nov. 1944).
11. "A New Series of Thermoplastic Resins," by C. L. Jones, MODERN PLASTICS *21*, 83–84, 166, 168 (July 1944).
12. "New High-Temperature Styrene," by C. L. Jones, Jr., and M. A. Brown, Jr., MODERN PLASTICS *21*, 93, 168 (Aug. 1944).
13. "Dichlorostyrenes and Their Polymers," by J. C. Michalek and C. C. Clark, Chem. Eng. News *22*, 1559–1563 (Sept. 25, 1944).
14. "Polyfibre—A New Approach to Molding," by W. C. Goggin and R. R. Bradshaw, MODERN PLASTICS *21*, 101–107, 164, 166 (July 1944).
15. "A New Name Among Vinyl Resins," by M. S. Moulton, MODERN PLASTICS *21*, 83–85, 162 (June 1944).
16. "Water-Dispersed Vinyl Resin," by G. W. Flanagan, MODERN PLASTICS *22*, 105–108 (Nov. 1944).
17. "Molding Via Grease Gun," MODERN PLASTICS *22*, 100, 178 (Sept. 1944).
18. "Vinyl Resin for Air-Dry and Low-Bake Coatings," by A. K. Doolittle and G. M. Powell, Paint, Oil and Chem. Rev. *107*, 9–11, 40–42 (Apr. 6, 1944).
19. "Resorcin Resins and Adhesives," by P. H. Rhodes, MODERN PLASTICS *22*, 160, 198 (Dec. 1944).
20. "New Developments in Furane Resins," by J. Delmonte, MODERN PLASTICS *21*, 102–104, 182 (Feb. 1944).
21. "Furfural Resin Adhesives for Aircraft Use," by J. Delmonte, Pacific Plastics *2*, 14–15 (Apr. 1944).
22. "Polymerization and Structure of Furfural Resins," by W. S. Penn, British Plastics *16*, 286–292 (July 1944).
23. "Allyl Plastics," by F. Strain, MODERN PLASTICS *21*, 97–99, 168, 170, 172 (Aug. 1944).
24. "Development of Glass-Reinforced Low-Pressure Plastics for Aircraft," by Col. P. H. Kemmer, MODERN PLASTICS *21*, 89–93 (May 1944).
25. "Application of Glass Laminates to Aircraft," by Capt. G. B. Rheinfrank, Jr., and Lt. W. A. Norman, MODERN PLASTICS *21*, 94–99 (May 1944).
26. "Forms, Properties and Handling of Glass Reinforcements" MODERN PLASTICS *21*, 100–103 (May 1944).
27. "Fabrication of Experimental Low-Pressure Laminates," MODERN PLASTICS *21*, 104–106 (May 1944).
28. "Machining Glass-Reinforced Low-Pressure Laminates," by F. E. Allen, MODERN PLASTICS *21*, 107–109 (May 1944).
29. "Desirable Handling Properties of Low-Pressure Resins," by J. D. Lincoln, MODERN PLASTICS *21*, 110–111 (May 1944).
30. "The Versatility of Low-Pressure Molding," by D. Swedlow, MODERN PLASTICS *21*, 112, 184, 186 (May 1944).
31. "Paper-Base Plastics. Part I. The Preparation of Phenolic-Laminated Boards," by H. L. Cox and K. W. Pepper, J. Soc. Chem. Ind. *63*, 150–154 (May 1944).
32. "Resins for Paper-Base Laminates," by N. D. Hanson and P. Wilson, Paper Trade J. *118*, 48–50 (Apr. 13, 1944).
33. "Paper-Base Laminates in Aircraft," by C. F. Marschner, MODERN PLASTICS *21*, 81–85, 168, 170 (Mar. 1944).
34. "Reinforced Laminates and Plastic Heater Panels," British Plastics *16*, 97–102 (Mar. 1944).
35. "Structural Composite Plastic Materials," by H. C. Engel and W. W. Troxell, MODERN PLASTICS *22*, 133–139, 170, 172 (Sept. 1944).
36. "Sandwich Construction," by N. J. Hoff and S. E. Mauntner, Aero. Eng. Rev. *3*, 29–43, 63 (Aug. 1944).
37. "Expanded Plastics," British Plastics *16*, 63–65 (Feb. 1944); Plastics *8*, 55–56 (Feb. 1944).
38. "Cellular Rubbers," by L. P. Gould, Rubber Age *54*, 526–530 (Mar. 1944); *55*, 65–67 (Apr. 1944).
39. "Preformed Plastics," Iron Age *154*, 56–57 (July 20, 1944).
40. "High-Strength Compound Shapes," by V. E. Calvin, MODERN PLASTICS *22*, 136–139, 192, 194 (Oct. 1944).
41. "Paper-Base and Wood Plastics," by A. J. Stamm, Pacific Pulp Paper Ind. *18*, 41–42, 45 (Feb. 1944).
42. "Comparison of Methods for Improving Wood," by L. Klein, H. Grinsfelder and S. D. Bailey, Ind. Eng. Chem. *36*, 252–256 (Mar. 1944).
43. "Convolute Winding of Plywood Tubing," MODERN PLASTICS *21*, 90, 170, 172 (Apr. 1944).
44. "Plywood for War," by T. D. Perry, Chem. Eng. News *22*, 700–705 (May 10, 1944).
45. "Methylolurea Advances Resin Impregnation of Wood," by J. F. T. Berliner, Chemical Industries *54*, 680–682 (May 1944).
46. "Delignified Impregnated Wood," by F. Luce, Mech. Eng. *66*, 654–655, 657 (Oct. 1944).
47. "Lignins and Their Plastics," by W. S. Penn, British Plastics *16*, 194–198 (May 1944).
48. "Hydrolysis of Lignocellulose," by R. M. Dorland, Chem. Eng. News *22*, 1352–1356 (Aug. 25, 1944).
49. "Developments in the Manufacture of Structural Products from Hydrolyzed Wood," by R. M. Boehm, Paper J. *118*, 35–38 (Mar. 30, 1944).
50. "Agricultural Residues for Use in Plastics," by T. F. Clark and S. I. Aronovsky, MODERN PLASTICS *22*, 162–164, 198 (Dec. 1944).
51. "Preparation and Properties of Starch Acetate," by L. T. Smith and R. H. Treadway, Chem. Eng. News *22*, 813–817 (May 25, 1944).
52. "Starch Adhesives," by L. T. Smith and R. M. Hamilton, Chem. Eng. News *22*, 1482–1484 (Sept. 10, 1944).
53. "Mechanical Properties of Films from Amylose, Amylopectin and Whole Starch Triacetates," by R. L. Whistler and G. E. Hilbert, Ind. Eng. Chem. *36*, 796–798 (Sept. 1944).
54. "Zinlac—A Shellac Substitute," by R. V. Townsend and C. G. Harford, Chem. Ind. *54*, 359 (Mar. 1944).
55. "New Plant First to Produce Zein on Commercial Scale," Chem. Ind. *54*, 670–671 (May 1944).
56. "Physical Structure of Phenoplasts," by R. A. Barkhuff, Jr., and T. S. Carswell, Ind. Eng. Chem. *36*, 461–466 (May, 1944).
57. "Solvent Immunization by Surface Hydrolysis of Molded Cellulose Esters," by W. M. Gearhart, MODERN PLASTICS *22*, 140–141, 172, 174 (Sept. 1944).
58. "Polyvinyl Alcohol," by I. Jones, British Plastics *15*, 380–384, 408; *16*, 77–83, 122–129 (Dec. 1943; Feb., Mar. 1944).
59. "A Fire-Fighting Horn," MODERN PLASTICS *21*, 116–118, 170, 172 (Jan. 1944).
60. "High Density Through High Frequency," by V. W. Sherman, MODERN PLASTICS *21*, 108–109, 172 (Mar. 1944).
61. "Progress in Heatronic Molding," by V. E Meharg and A. P. Mazzucchelli, MODERN PLASTICS *21*, 108–113, 160, 162 (June 1944).
62. "High Frequency Solves Molding Problems," by L. L. Dawson, MODERN PLASTICS *21*, 114–115, 178 (Aug. 1944).
63. "R-F Heating for Fabricating Wood Aircraft," by J. P. Taylor, Electronics *17*, 108–113 (Mar. 1944).
64. "Fabricating Wood Aircraft 'Skins,'" by J. P. Taylor, Electronics, *17*, 102–107, 391–392 (Apr. 1944).
65. "Dielectric Heating Speeds Curing of Plastic Laminates," by R. W. Auxier, Product Eng. *15*, 299–301 (May, 1944).
66. "The Principles of High-Frequency Heating," by L. Hartshorn, Chemistry and Industry *1944*, 322–325 (Sept. 9, 1944).
67. "Short Waves and Transfer Molding," by J. P. Moran and G. P. Bohrer, MODERN PLASTICS *21*, 116–118, 166, 168 (June 1944).
68. "A Multi-Purpose Molding Machine," by N. J. Rakas and W. B. Cousino, MODERN PLASTICS *22*, 133–141, 196, 198 (Dec. 1944).
69. "Rapid Continuous Injection Molding of Thermosetting Materials," MODERN PLASTICS *21*, 90–91 (Jan. 1944).
70. "New Machine Adapted to Three Separate Molding Processes," MODERN PLASTICS *21*, 164–165, 194 (May 1944).
71. "Two New Injection Machines," MODERN PLASTICS *21*, 166–167 (May 1944).
72. "New 16-oz. Injection Machine," MODERN PLASTICS *22*, 178, 180 (Oct. 1944).
73. "New Method of Molding by Extrusion," by A. D. Ferguson, MODERN PLASTICS *22*, 186, 206 (Dec. 1944).
74. "Extrusion of Ethyl Cellulose Plastic," MODERN PLASTICS *21*, 132–134, 180 (Feb. 1944).
75. "The Extrusion of Saran," by J. A. Palmer, MODERN PLASTICS *22*, 141–146 (Nov. 1944).
76. "Injection Mold Design," by Islyn Thomas, MODERN PLASTICS *21*, 103–105, 164 (June 1944); 110–114 (July 1944).
77. "Types of Transfer Mold," by J. H. DuBois, MODERN PLASTICS *22*, 134–135, 190 (Oct. 1944).
78. "Transfer Mold Design Considerations," by J. H. DuBois, MODERN PLASTICS *22*, 138–140, 206 (Nov. 1944).
79. "Plastics in Structural Design," by V. E. Meharg and L. E. Welch, MODERN PLASTICS *22*, 117–119, 182 (Sept. 1944).
80. "Molded Threads," by J. E. Ball, British Plastics *16*, 207 (May 1944).
81. "Knowledge of Shrinkage Aids in Design of Plastic Parts," by C. R. Simmons, Product Eng. *15*, 414–415 (June 1944).
82. "Designing for Plastic Molding," by W. M. Halliday, Plastics (London) *8*, 76–83, 129–140, 188–192, 292 (Feb., Mar., Apr., June 1944).
83. "Cooling Water Costs in Injection Molding," by G. W. DeBell,

Select your molding equipment from this W-S COMPLETE LINE



Presses shown above are but three of the many manufactured by Watson-Stillman

No matter what plastic products you want to mold—what materials you want to use—you can get the right machine for any molding job from Watson-Stillman . . . builders of the most complete line of hydraulic equipment available for compression *and* injection molding on large scale production, diversified short runs or in the laboratory. All Watson-Stillman equipment embodies operating and production features consistent with latest trends in plastic materials and molding techniques. At Watson-Stillman you can also get—without obligation—unbiased advice on selecting equipment or other molding problems, based on intimate association with the Plastics Industry from its very beginning. Write the Watson-Stillman Company, Roselle, New Jersey.

The Complete Line Includes:

- AUTOMATIC COMPRESSION MOLDING MACHINES 25-75 TONS
- SEMI-AUTOMATIC COMPRESSION MOLDING MACHINES 50-850 TONS
- VERTICAL INJECTION MOLDING MACHINES 2 OZ. CAPACITY
- HORIZONTAL INJECTION MOLDING MACHINES 8 to 28 OZ. CAPACITIES
- ANGLE MOLDING PRESSES
- DIE SINKING AND HOBBING PRESSES 150 TO 2000 TONS CAPACITIES
- PREFORMING PRESSES 75 TONS CAPACITY
- LAMINATING PRESS 2000 TON
- LABORATORY PRESSES 20-200 TONS
- STEDIFLO PUMPS 3-200 H. P.
- GENERAL PURPOSE PRESSES FOR UTILITY MOLDING AND LABORATORY TESTING 20-200 TONS
- HORIZONTAL PUMPS 2-200 H. P.
- ACCUMULATORS—HYDRO-PNEUMATIC
- ACCUMULATORS WEIGHTED
- MOLDING PRESS 75-TON, 3-UNIT
- SEMI-AUTOMATIC MOLDING PRESSES—ACCUMULATOR OPERATED
- PLAIN HEATING AND CHILLING PRESSES—ACCUMULATOR OPERATED
- HINGED TOP RECORD PRESSES
- HAND PUMP
- VALVES AND FITTINGS

WATSON-STILLMAN

Designers and Manufacturers of Hydraulic Equipment, Forged Steel Fittings, and Valves

MODERN PLASTICS *21*, 112–113, 178 (Mar. 1944).

83A. "Factors in Molding Cellulose Derivatives," by W. O. Bracken and F. E. Pisch, Ind. Eng. Chem. *36*, 452–456 (May 1944).

84. "Extrusion Blowing of Thermoplastics," by H. Griffiths, MODERN PLASTICS *21*, 78–81, 166, 168 (Aug. 1944).

84A. "Infrared for Drying and Preheating," by W. J. Miskella, MODERN PLASTICS *21*, 110–111, 182 (Aug. 1944).

85. "Control of Compression Equipment," by C. F. Massopust and A. J. Potts, MODERN PLASTICS *22*, 122–123, 178, 180, 182 (Sept. 1944).

86. "Process for Making Molds by Electrodeposition," by P. Spiro, Plastics (London) *8*, 229–231 (May 1944).

87. "Kirksite Molds for Plastics," by C. C. Sachs, Iron Age *153*, 71–75 (Apr. 20, 1944).

88. "Vacuum Forming Speeds Plastics Sheet Production," by E. Greene, Aero Digest *45*, 112, 114, 116 (May 1, 1944).

89. "Air Forming Methods Speed Plastics Fabrication," Chem. Ind. *54*, 850–851 (June 1944).

90. "The Fortress Gets Another Nose," by T. Gladwin, MODERN PLASTICS *22*, 97–101 (Oct. 1944).

91. "Molding of Thermoplastic Sheet," MODERN PLASTICS *22*,103–105 (Dec. 1944).

92. "Metallizing Plastics," by E. E. Halls, Plastics (London) *7*, 235–243, 281–286, 337–348, 400–407, 429–432, 486–495, 507, 549–561; *8*, 4–9, 112–123, 154–165, 204–208 (June-Dec. 1943; Jan., Mar.–May 1944).

93. "Metallizing Turret Cylinders," by J. M. Crone, MODERN PLASTICS *22*, 126–127, 192 (Sept. 1944).

94. "Metal Plating of Plastics," Canadian Metals and Metallurgical Ind. *7*, 33–34 (Feb. 1944).

95. "Electrophoretic Finishing," by E. J. Roehl, Metal Finishing *42*, 313–316 (May 1944).

96. "The Spreader Method for the Manufacture of Compregnated Wood," by H. W. MacKinney and L. Repsher, MODERN PLASTICS *21*, 103–105, 166, 168 (Mar. 1944).

97. "A New Gluing Process," by W. Gallay and G. G. Graham, MODERN PLASTICS *21*, 126–129, 168, 170, 172 (Feb. 1944).

98. "Plywood Bonding," by H. Grinsfelder and M. R. Collins, Ind. Eng. Chem. *36*, 152–157 (Feb. 1944).

99. "Calculating Time-Temperature Schedules for Curing Resin Adhesives," by T. D. Perry, MODERN PLASTICS *22*, 153–154 (Oct. 1944).

100. "Low-Pressure Laminating Adaptable to Large Parts," by T. N. Willcox, Product Eng. *15*, 386–388 (June 1944).

101. "High-, Low-, and No-Pressure Laminates," by C. C. Sachs, MODERN PLASTICS *21*, 80–83, 172, 174 (July 1944).

102. "Safety Helmets," by LeGrand Daly, MODERN PLASTICS *21*, 82–83, 160, 162 (Aug. 1944).

103. "Thermo-elastic Forming of Laminates," by W. I. Beach, MODERN PLASTICS *22*, 132–135, 206, 208 (Nov. 1944).

104. "Forming Properties of Vulcanized Fibre Sheet," by C. A. Hedges, Automotive Aviation Ind. *90*, 40, 64 (Apr. 1, 1944).

105. "Laminated Bomb Burster Tube," MODERN PLASTICS *21*, 119–123 (Feb. 1944).

106. "The M-52 Trench Mortar Fuze," MODERN PLASTICS *21*, 101–114, 162, 164 (Apr. 1944).

107. "Gun Butts for the Browning Semi-Automatic," MODERN PLASTICS *21*, 86–87, 174 (July 1944).

108. "Coatings for Steel Cartridge Cases," by R. A. Brenneck and R. L. Norum, Metal Finishing *42*, 245–247 (Apr. 1944).

109. "Pill Boxes for Our Soldiers," MODERN PLASTICS *21*, 110–111, 182 (Feb. 1944).

110. "The Portable X-ray Field Unit," MODERN PLASTICS *21*, 91–92, 180 (Aug. 1944).

111. "Army Mess Tray," by L. T. Bordner, MODERN PLASTICS *21*, 90–91, 172 (Mar. 1944).

112. "War as a Proving Ground," by C. C. Austin, Jr., MODERN PLASTICS *22*, 103–104, 198 (Oct. 1944).

113. "On the Mark," MODERN PLASTICS *21*, 95, 164, 166 (June 1944).

114. "Sighted Sub, Sank Same," by L. C. Mackrill, MODERN PLASTICS *21*, 83–86, 184, 186 (Jan. 1944).

115. "A Self-Contained Compass," by C. Lichtenberg, MODERN PLASTICS *21*, 87–89, 170 (Mar. 1944).

116. "Three Newcomers," MODERN PLASTICS *21*, 121–123, 188 (May 1944).

117. "Anti-Fouling and Anti-Corrosive Compositions," by J. H. Davey, Metal Finishing *42*, 60–63 (Jan. 1944).

118. "Rocket Launching Tubes," MODERN PLASTICS *22*, 127–129, 204, 206 (Nov. 1944).

119. "The 6 × 42 Binocular," by W. R. Bailey and G. M. Kline, MODERN PLASTICS *22*, 105–110, 198, 200, 202, 204 (Oct. 1944).

120. "The Future of Plastics in Aviation," by W. Ward Jackson, MODERN PLASTICS *21*, 100–103, 174, 176 (Jan. 1944).

121. "Plastic Airplane Parts Stand Test of Time," Aero Digest *45*, 89, 100, 216, 218 (Apr. 15, 1944).

122. "Structural Features in German Aircraft," by D. M. A. Leggett and J. H. H. Davison, J. Roy. Aero. Soc. *48*, 167–201 (June 1944).

123. "Glider Control Tabs," MODERN PLASTICS *21*, 87–89 (Jan. 1944).

124. "Molded-Laminated Phenolic Propeller Parts for Aircraft," MODERN PLASTICS *21*, 109–113, 170 (Jan. 1944).

125. "Checking the Angles," MODERN PLASTICS *22*, 107 (Sept. 1944).

126. "Powering a Rotating Turret," MODERN PLASTICS *22*, 125–127, 186, 188 (Oct. 1944).

127. "High-Flying Oxygen Valve," by I. G. Goddard and I. Goldberg, MODERN PLASTICS *22*, 110–111, 210 (Nov. 1944).

128. "Portable Hangars for Navy Aircraft," MODERN PLASTICS *22*, 109, 210 (Nov. 1944).

129. "Pelorus Drift Sight," by N. G. Levien, MODERN PLASTICS *21*, 120 (May 1944).

130. "Metal Plus Plastics Makes New Aircraft Flooring," Aviation *43*, 130–131, 240, 243 (Apr. 1944).

131. "A Lightweight Floor for Airplanes," by J. R. Fitzpatrick, Mech. Eng. *66*, 705–709 (Nov. 1944).

132. "Lights That Talk," by E. F. Lougee, MODERN PLASTICS *22*, 101–102, 184 (Sept. 1944).

133. "Shatter-Resistant Plastic Glazing," by G. M. Kuettel, MODERN PLASTICS *21*, 85–89, 180 (Aug. 1944).

134. "Safety Glass for Airplanes," by J. H. Sherts, Aero Digest *46*, 99–101, 137 (Aug. 15, 1944).

135. "Streamlined Eye Section for the B-29," by F. L. Williamson, MODERN PLASTICS *22*, 148, 200, 202 (Dec. 1944).

136. "Economical Tooling for Aircraft Parts," by C. C. Sachs, MODERN PLASTICS *21*, 124–128, 178, 180 (May 1944).

137. "Economical Tooling of Aircraft Parts," by D. A. Cook, MODERN PLASTICS *22*, 140–141, 206 (Oct. 1944).

138. "Basic Advantages of All-Plastic Dies and Die-Sets," by D. Cook, Aero Digest *44*, 106, 108 (Feb. 1, 1944).

139. "Convair's New Tooling Plastic," by T. A. Dickinson, Aero Digest *45*, 100–101, 220 (June 1, 1944).

140. "Bonding Metal to Wood," by Corydon M. Grafton, MODERN PLASTICS *22*, 103, 194, 196 (Sept. 1944).

141. "Metlbond—A Metal Adhesive for Aircraft," by G. G. Havens, Mech. Eng. *66*, 713–714, 736 (Nov. 1944).

142. "Planes in Envelopes," Modern Packaging *18*, 108–109, 162 (Nov. 1944).

143. "Plastic Dipping," by H. Forsberg, Iron Age *153*, 54–55 (Feb. 3, 1944).

144. "Plastics and Architecture," MODERN PLASTICS *22*, 117–119 (Dec. 1944).

145. "Plastics and Their Place in Post-War Building," by H. H. Lusty, British Plastics *16*, 55–60, 116–118 (Feb., Mar. 1944).

146. "Prefabrication and Plywood," British Plastics *16*, 144–147 (Apr. 1944).

147. "Plastics in Postwar Building," Plastics (London) *8*, 267–269 (June 1944).

148. "Plastics for Housing," British Plastics *16*, 238–242 (June 1944).

149. "The Hub of the Home," by J. D. Lincoln, MODERN PLASTICS *22*, 118–121, 194 (Oct. 1944).

150. "Studies in Lighting Fixtures," MODERN PLASTICS *21*, 98–100 (Apr. 1944).

151. "The Case for Synthetic Textiles," MODERN PLASTICS *22*, 91–97, 184, 186, 188, 190, 192 (Sept. 1944).

152. "Synthetic Fibers and Their Future Development," Am. Dyestuff Rep. *33*, 121–128 (Mar. 13, 1944).

153. "Artificial Fibers from Corpuscular and Fibrous Proteins," by H. P. Lundgren and R. A. O'Connell, Ind. Eng. Chem. *36*, 370–374 (Apr. 1944).

154. "Physico-Chemical Properties of Textile Nylon Yarns," Rayon Textile Monthly *25*, 169–171, 221–223 (Apr., May 1944).

155. "Lacquer-Type Fabric Coatings," by D. McBurney, MODERN PLASTICS *21*, 93–95, 172, 174 (Jan. 1944).

156. "Coating Nylon Fabrics for Military Use," Textile World *94*, 112–113 (Apr. 1944).

157. "Machines and Methods for Plastic Coatings," by J. B. Cleaveland, Textile World *94*, 74–76 (Mar.); 90–91 (May); 107, 111 (June); 81, 83, 85, (July 1944.)

158. "Reducing Wool Shrinkage and Felting with Melamine Resins," by E. P. Johnstone, Am. Dyestuff Reporter *33*, 301–303 (July 3, 1944).

159. "Plastics in the Plating Industry," by H. Narcus, Metal Finishing *42*, 401–404, 470–474 (July, Aug. 1944).

160. "Plastic Material for Electroplating Shields," by H. W. Tompkins, Aero Digest *46*, 109–112, 130 (July 15, 1944).

161. "Synthetics in Shoes," by Wilfred Gallay, MODERN PLASTICS *21*, 95–98, 180, 182 (Feb. 1944).

162. "Synthetic Resins in the Paper Industry," by L. Klein, Chem. Ind. *54*, 364–367 (Mar. 1944).

163. "Phenolic Resin Baking Finishes for Protection Against Corrosion," by R. L. Norum, Chem. Ind. *54*, 524–528 (Apr. 1944).

164. "Urea-Formaldehyde Water-Thinned Paint," by J. K. Wise, Ind. Eng. Chem. *36*, 144–147 (Feb. 1944).

165. "Nylon Bristles for Paint Brushes," by D. D. Payne, MODERN PLASTICS *21*, 94–95 (Mar 1944).

166. "New Trends in Railroad Lighting," by L. Schepmoes, MODERN PLASTICS *21*, 96–97 (Jan. 1944).

167. "Plastics—Their Application to Road Vehicles," by F. Walls and J. E. Sisson, Automobile Eng. *34*, 157–162 (Apr. 1944).

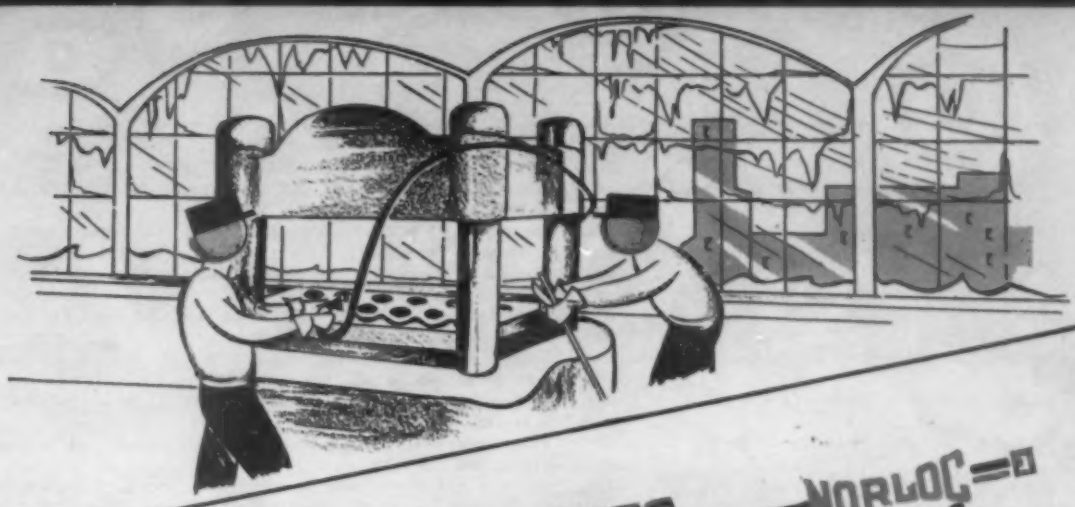
168. "Plastic Four-Wheeled Passenger Van," The Engineer *177*, 188–189 (Mar. 10, 1944).

169. "Plastics—Some Recent Developments and Innovations," by W. Nichols, Automobile Eng. *34*, 187–189 (May 1944).

170. "Vinsol-Resin-Treated Cements and Their Use in Highway Construction," by J. F. Barbee, Concrete (Mill ed.) *52*, 103–104, 108 (Jan. 1944).

171. "Sculptured Restorations," MODERN PLASTICS *21*, 93–94, 156 (June 1944).

(*Please turn to next page*)



NORTON LABORATORIES (INCORPORATED)

CUSTOM MOULDERS OF SYNTHETIC PLASTICS

BAKELITE DUREZ

LOCKPORT, N.Y.

NORLOC NOVELTIES

ALL AGREEMENTS ARE CONTINGENT UPON STRIKES, FIRES, ACCIDENTS OR CAUSES BEYOND OUR CONTROL. CONTRACTS WITH AGENTS NOT VALID UNTIL APPROVED BY AN OFFICER

January 1945

Dear Friends:

It has been a cold winter up here in Lockport. We have had plenty of snow and plenty of ice but it's nice and warm in our plant. Things are humming. And the reason for which we can't possibly take all the credit is the fact that we are part of the plastics industry—a great, booming field.

We mold plastics—all of them—for a number of important companies. We like our business because it is so constantly different—constantly changing from day to day. There is little repetition in our work. A good part of it still consists of exploration and experimentation, development and new design. Because plastics are still young materials. This is not to say that they are untried, by any means. But once having performed well in one application, so many new possibilities arise that the stream of new products and new developments through our plant never ends.

Perhaps, you may be thinking along the lines of plastics development now. If so, here is one company which knows plastics, has a good background in molding them, and would like to work with you in developing them for your products and your industry.

Sincerely yours,

M. L. Seekins

M. L. SEEKINS
Factory Manager

172. "Acrylic for Artificial Eyes," MODERN PLASTICS *21*, 88–89, 168 (July 1944).

173. "Acrylic for Surgery," MODERN PLASTICS *22*, 111, 196 (Oct. 1944).

174. "Developments in Pattern Plates," MODERN PLASTICS *21*, 84, 168, 170 (Apr. 1944).

175. "Plastic Impregnation of Magnesium Castings," Iron Age *154*, 63 (Aug. 10, 1944).

176. "Thermoplastic Cables," by H. Barron, J. N. Dean, and T. R. Scott, J. Inst. Elec. Eng. *91*, Part 2, 297–309 (Aug. 1944).

177. "Putting on the Brakes," by C. R. Simmons, MODERN PLASTICS *22*, 124, 196 (Oct. 1944).

178. "Postwar Uses for Luminescent Pigments," by V. A. Becher, MODERN PLASTICS *21*, 105–107, 182 (Feb. 1944).

179. "Realities or Reveries," MODERN PLASTICS *21*, 73–81, 172, 174, 176, 178 (Apr. 1944).

180. "The Ups and Downs of Color," MODERN PLASTICS *21*, 81–88 (May 1944).

181. "Information Please," MODERN PLASTICS *21*, 75–82, 168, 170, 172 (June 1944).

182. "Effect of High Relative Humidities in Producing Changes in Dimensions of Plastics," by A. C. Titus, Plastics and Resins Ind. *3*, 12–14 (Aug. 1944).

183. "Effect of Environmental Conditions on Cellulose Acetate and Nitrate Sheets," by T. S. Lawton, Jr., T. S. Carswell and H. K. Nason, MODERN PLASTICS *22*, 145–152, 188 (Oct. 1944).

184. "Hot Forming of Phenolic Laminates," by H. C. Guhl.

185. "Creep Properties of Molded Phenolic Plastics at Elevated Temperatures," by W. J. Gallus and D. Telfair.

186. "Effect of Some Environmental Conditions on the Permanence of Cellulose Acetate and Cellulose Nitrate Sheet Plastics," by T. S. Lawton, Jr., and H. K. Nason.

187. "Properties and Development of Papreg, High Strength Laminated Paper Plastic," by E. C. O. Erickson and G. E. Mackin.

188. "Behavior of Synthetic Phenolic-Resin Adhesives in Plywood Under Alternating Stresses," by A. G. H. Dietz and H. Grinsfelder, Trans. A.S.M.E. *66*, 319–328 (May 1944).

189. "Fatigue Studies on Urea Assembly Adhesives," by A. G. H. Dietz and H. Grinsfelder, Trans. A.S.M.E. *66*, 442–446 (July 1944); MODERN PLASTICS *21*, 119–122, 160, 162 (Apr. 1944).

190. "Physical Properties of a Structural Plastic Material," by C. W. Armstrong, Trans. A.S.M.E. *66*, 135–138 (Feb. 1944).

191. "Wood-Cloth and Wood-Paper Laminates," by John Delmonte, Trans. A.S.M.E. *66*, 55–59 (Jan. 1944).

192. "Compreg as a Laminated Wood and as a Plastic," by J. F. Dreyer, Mech. Eng. *66*, 710–712 (Nov. 1944).

193. "Problems of Construction and Alternate Substitutions in Wood Aircraft," by J. M. Stevens, Trans. A.S.M.E. *66*, 155–159 (Feb. 1944).

194. "Plastic Plywoods in Aircraft Construction," by R. D. Hiscocks, Trans. A.S.M.E. *66*, 169–175 (Apr. 1944).

195. "Radio-Frequency Technology in Wood Applications," by G. F. Russell and J. W. Mann, Trans. A.S.M.E. *66*, 563–567 (Aug. 1944).

196. "Postwar Availability and Use of Wood," by F. J. Hanrahan, Mech. Eng. *66*, 649–653 (Oct. 1944).

197. "Microstructure of High-Density Plywood," by W. M. Harlow, Mech. Eng. *66*, 656–657 (Oct. 1944).

198. "Symposium on Plastics," Philadelphia: American Society for Testing Materials (1944).

199. "Heat Resistance of Laminated Plastics," by E. O. Hausmann, A. E. Parkinson and G. H. Mains, MODERN PLASTICS, *22*, 151–154, 190, 192, 194, 196, 198 (Nov. 1944).

200. "Effect of Environmental Conditions on Mechanical Properties of Organic Plastics," by T. S. Carswell and H. K. Nason, MODERN PLASTICS *21*, 121–126, 158, 160 (June 1944); 125–130, 160, 162 (July 1944).

201. "Diffusion of Water Through Plastics," by G. Deeg, Jr., and C. J. Frosch, MODERN PLASTICS *22*, 155–156, 198, 200, 202 (Nov. 1944).

202. "Stiffness and Brittleness of Nonrigid Vinyl Chloride-Acetate Resin Compounds," by R. F. Clash, Jr., and R. M. Berg, MODERN PLASTICS *21*, 119–124, 160 (July 1944).

203. "The Behavior of Plastic Materials Under Repeated Stress," by B. J. Lazan and A. Yorgiadis, MODERN PLASTICS *21*, 119–128, 164 (Aug. 1944).

204. "Testing in Connection with the Development of Strong Plastics or Aircraft," by H. Sang.

205. "Creep Characteristics of Plastics," by W. N. Findley, MODERN PLASTICS *22*, 153–159, 194, 196 (Dec. 1944).

206. "Indentation Hardness of Plastics," by L. Boor.

207. "Impact Testing of Plastics. II. Factors Which Influence the Energy Absorbed by the Specimen," by D. Telfair and H. K. Nason.

208. "Short-Time Static Tests and Creep Tests of a Paper Laminated Plastic," by W. N. Findley and W. J. Worley.

209. "Flow of Thermosetting Plastics at Elevated Temperatures," by J. Delmonte and E. Watkins.

210. "Fatigue Tests on Compressed and Impregnated Laminated Wood," by A. G. H. Dietz and H. Grinsfelder, A.S.T.M. Bulletin No. 129, 31–34 (Aug. 1944).

211. "Creep Properties of Molded Phenolic Plastics," by D. Telfair, T. S. Carswell and H. K. Nason, MODERN PLASTICS *21*, 137–144, 174, 176 (Feb. 1944).

212. "Creep and Time-Fracture Strength of Plastics Under Tensile Stresses," by B. Chasman, MODERN PLASTICS *21*, 145–148, 176 (Feb. 1944).

213. "Creep Characteristics of Cellulose Acetate Plastic," by W. N. Findley, Aviation 43, 143–149, 263, 265, 269 (June); 164–165, 263–264 (July); 163–165, 260–264 (Aug. 1944).

214. "Shear Strength of Plastic Materials," by R. T. Schwartz and E. Dugger, Jr., MODERN PLASTICS *21*, 117–121, 164, 166 (Mar. 1944).

215. "Method for Estimating the Shear Modulus of Elasticity," by L. E. Welch, Product Eng. *15*, 215–216 (Mar. 1944).

216. "Impact Strength of Reinforced Plastics," by P. M. Field, MODERN PLASTICS *21*, 123–125, 162 (Apr. 1944).

217. "Bearing Strength of Plastic Materials," by R. T. Schwartz and E. Dugger, Jr., MODERN PLASTICS *21*, 133–137, 180, 182, 184 (May 1944).

218. "Thermoplastic Flow of Polystyrene," by N. M. Foote, Ind. Eng. Chem. *36*, 244–248 (Mar. 1944).

219. "Flow Properties of Cellulose Esters," by C. J. Frosch, Bell Laboratories Record *22*, 269–272 (1944).

220. "Effect of Altitude on Electrical Insulation," by C. J. Berberich, A. M. Stiles, G. L. Moses, G. G. Veinott, Aero Digest *45*, 84–86, 207–210 (Apr. 1, 1944); 122, 124, 126, 224–225 (May 15, 1944).

221. "Elasto-Viscous and Stress-Optical Properties of Commercial Polymerized Methyl Methacrylate as a Function of Temperature," by H. A. Robinson, R. Ruggy and E. Slantz, J. Applied Physics *15*, 343–351 (Apr. 1944).

222. "Thermal Expansion Properties of Plastic Materials," by R. F. Clash, Jr., and L. M. Rynkiewicz, Ind. Eng. Chem. *36*, 279–282 (Mar. 1944.)

223. "Thermal Expansion and Second-Order Transition Effects in High Polymers," by R. F. Boyer and R. S. Spencer, J. Applied Physics *15*, 398–405 (Apr. 1944).

224. "Determination of Water Absorption by Changes in Dimensions," by J. Delmonte and L. Asselin, MODERN PLASTICS *21*, 138, 188 (May 1944).

225. "Effect of Moisture on the Physical Properties of Paper-Base Plastics," by A. H. Croup, Paper Trade J. *118*, 43–46 (May 18, 1944).

226. "Water-Vapor Permeability of Certain Coated Fabrics," by J. T. Stearn and A. S. Cooper, Jr., Am. Dyestuff Rep. *33*, 150–155 (Mar. 27, 1944).

227. "Determination of Water Vapor Permeability," by C. G. Weber, Paper Trade J. *118*, 36–38 (Jan. 20, 1944).

228. "Tests at the Institute of Paper Chemistry," by G. R. Sears, H. A. Schlagenhauf, J. C. Givens and F. R. Yett, Paper Trade J. *118*, 39–40 (Jan. 20, 1944).

229. "Apparatus for Measuring the Gas Permeability of Film Materials of Low Permeability," by A. C. Shuman, Ind. Eng. Chem., Anal. Ed. *16*, 58–60 (Jan. 15, 1944).

230. "Apparatus for Measuring Gas Transmission Through Sheets and Films," by H. R. Todd, Paper Trade J. *118*, 32–35 (Mar. 9, 1944).

231. "Plywood Characteristics Disclosed by Vibration Tests," by A. J. Yorgiadis and J. M. Robertson, Aero Digest *45*, 76–77, 80–81, 196, 189, 201–202, 204 (Apr. 1, 1944).

232. "Effect of Prolonged Heating on Some Physical Properties of Compreg," by D. Baker and J. E. Gurvitch, MODERN PLASTICS *22*, 142, 176, 178 (Sept. 1944).

233. "Characteristics of Phenolic Laminates," by D. W. Brown, Plastics (London) *8*, 177–186 (Apr. 1944).

234. "Effects of Thermo-Elastic Forming on Properties of Thermosetting Laminates," by W. I. Beach, MODERN PLASTICS *21*, 127–131, 186, 188 (Jan. 1944).

235. "Characteristics of Plastics as Engineering Materials," by W. F Bartoe and D. S. Frederick, S.A.E. Journal *52*, 54–61 (Feb. 1944).

236. "Fact and Fancy in Modern Plastics Design," Plastics (London) *8*, 170–176 (Apr. 1944).

237. "Interpretation of Mechanical Data Necessary in Plastic Part Design," by W. S. Larson, Product Eng. *15*, 469–472 (July 1944).

238. "Solubility of Certain Plasticizers in Liquid Ammonia," by P. C. Scherer and E. O. Sternberg, Rayon Textile Monthly *25*, 143–145 (Mar. 1944).

239. "Conduct of Amino Acids in Synthetic Ion Exchangers," by D. T. Englis and H. A. Fiess, Ind. Eng. Chem. *36*, 604–609 (July 1944).

240. "The Analysis of Resin Finishes," by F. P. Brennan, Rayon Textile Monthly *25*, 339–341 (July 1944).

241. "Identification of Natural and Synthetic Rubbers," by H. P. Burchfield, Ind. Eng. Chem., Anal. Ed. *16*, 424–426 (July 1944).

242. "Systematic Procedure for Identification of Synthetic Resins and Plastics," by T. P. G. Shaw, Ind. Eng. Chem., Anal. Ed. *16*, 541–549 (Sept. 1944).

243. "Determining Plasticizer Content of Cellulose Esters," B. S. Biggs and R. H. Erickson, Ind. Eng. Chem., Anal. Ed. *16*, 93–94 (Feb. 1944).

244. "Preliminary Studies on a Drop Ball Impact Machine," by G. Lubin and R. R. Winans, A.S.T.M. Bulletin No. 128, 13–18 (May, 1944).

245. "A Photo-Electric Photometer for Measuring the Light Scattered by the Surface of a Transparent Material," by J. M. Sowerby, J. Sci. Instruments *21*, 42–45 (Mar. 1944).

246. "Report of A.S.T.M. Committee D-20 on Plastics," 1944 Preprint, Annual Meeting, June 1944.

247. "Standards for Fittings and Tubings," by W. M. White, MODERN PLASTICS *21*, 122–124, 162, 164 (Mar. 1944).

248. "Tolerances for Laminated Plastics," by A. B. Eastman, MODERN PLASTICS *21*, 94–95, 166, 168 (Apr. 1944).

249. "New A.S.T.M. Technical Committee on Adhesives," A.S.T.M. Bulletin No. 129, 29–30 (Aug. 1944).

MANUFACTURERS OF PRECISION-MADE PULP AND PAPERS FOR MORE THAN FORTY YEARS • THE MUNISING PAPER COMPANY

MUNISING PAPER

PRECISION-MADE PULP AND PAPERS FOR THE PLASTICS INDUSTRY:

SUBJECT: CUSTOM BUILT IMPREGNATING PAPERS

A manufacturer of impregnating papers can make a line of standard stock papers, or he can custom-build papers to meet specific conditions.

For the plastics industry, MUNISING has followed the policy of making only custom-built papers. Because of the varying requirements of individual laminators, any so-socalled all-purpose stock paper would tend to be a compromise of many needs

We believe it logical that we continue to make paper to fit each customer's requirements. Should custom-made paper manufacturing be applicable to your needs, may we suggest you contact us?

THE MUNISING PAPER COMPANY

Sales and Executive Offices:
135 S. La Salle St., Chicago 3, Illinois

Pulp and Paper Mills
Munising, Michigan

HARDESTY CHEMICAL COMPANY

PLASTICIZERS

...when you want it...as you want it

THE first shipment of Hardesty Chemical Company's plasticizers will convince you that their consistent high quality can help you achieve peak production. Hardesty Chemical Company is now in production on these plasticizers and invites your study of these products which are now available. Send for your sample today.

DIBUTYL SEBACATE

Purity	98.5% Minimum
Specific gravity	0.935 20/20°C
Acidity as Sebacic	0.3% Maximum
Color	15Y, 3.5R
Butanol	0.1% Maximum
Flash Point	380°F
Boiling Point	344°C. @ 760 mm.
	175-180°C @ 3 mm.
Water solubility	Less than 1% @ 25°C
Freezing point	11°F
Weight per gallon	7.8 lbs.
Index of refraction	1.4391 @ 25°C
Dielectric constant	3.6
Power factor—60 cycles	6

BUTYL ROLEATE

Free Fatty acid	2%
Butanol	0.2%
Moisture	0.2%
Color	Red

SEBACIC ACID

Specific Gravity	1.085 25/15°C
Melting Point	128°C
Neutralization equivalent	102
Free Fatty Acid	98.5%
Moisture	0.15%
Mol. weight	202.14

CAPRYL ALCOHOL

Specific Gravity	0.815/20°C
Mol. weight	130.23
Flash point	172°F
Distillation range	176.8/179.9°C
Refractive index	1.4266 @ 20°C
Lbs. per U. S. gallon	6.81
Boiling point	178/179°C
Moisture	0.25%

HARCHEM

PLASTICIZERS

Alkyl Roleates

Dibutyl Sebacate

Sebacic Acid

Capryl Alcohol

HARDESTY CHEMICAL COMPANY, INC., 41 EAST FORTY-SECOND STREET, NEW YORK 17, N.Y.

THESE PLASTIC PILLS

can kill tubes *Fast!*

. . . unless they are designed for the job

Faster and more uniform heating of preforms is now being achieved with electronic heating. For this unusual function the Scientific Electric Company of Garfield, N. J. builds High Frequency Vacuum Tube Generators distinguished for their rugged, compact construction and advanced engineering design.

The heart of these units is a tough proving ground for tube stamina. Every plastic preform requires a specific power and frequency combination. The resulting variations of load and frequency encountered greatly shortens the life of the *average* tubes built to *ordinary* standards. Only specially designed tubes can stand the "gaff."

Scientific Electric Engineers approve the installation of United Mercury Power Rectifiers and Heavy Duty Oscillators in all S.E. Dielectric Heaters. Underlying this preference for United Tubes is their sterling workmanship—unusual physical ruggedness and inherent stability under changing loads and frequencies.

Be guided by Engineers who have pioneered in Electronic Heating since 1921. Standardize on tubes by UNITED. Get the facts about these better rectifiers and oscillators today. Write for technical data and tube interchange information.

For sustained efficiency and economical operation Scientific Electric High Frequency Heaters depend on Tubes by UNITED

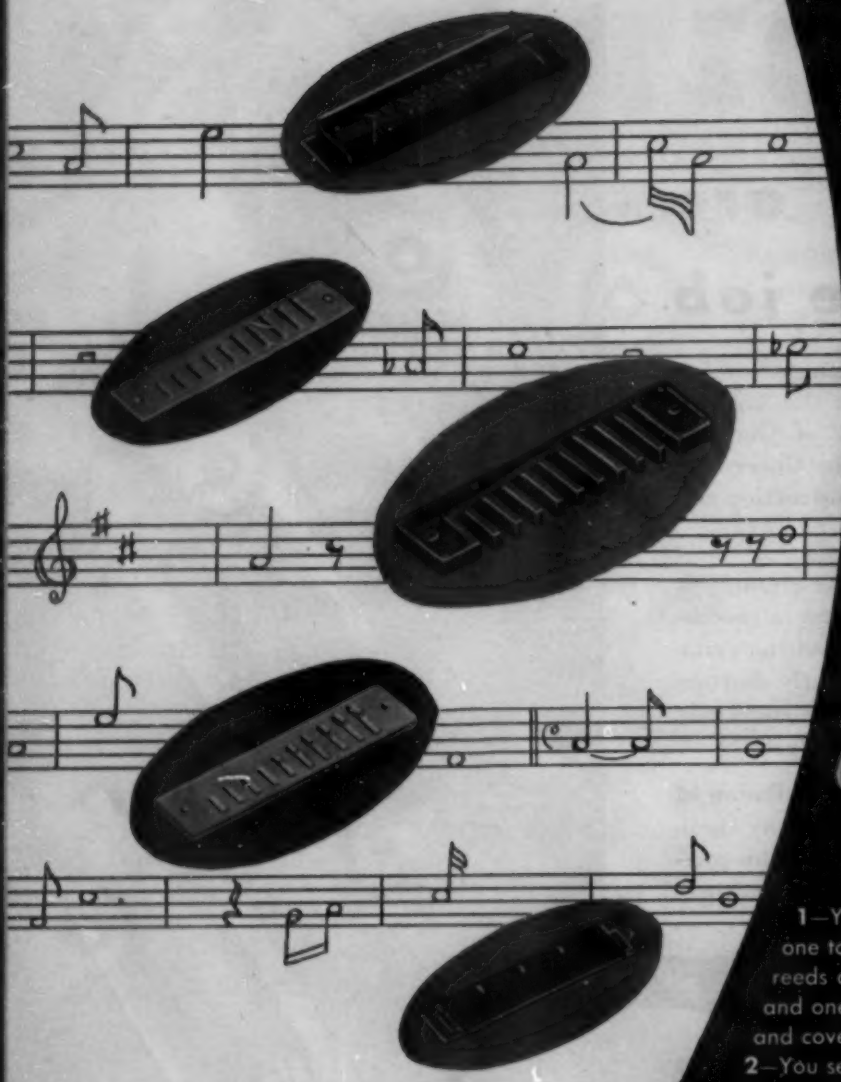
UNITED

ELECTRONICS COMPANY

NEWARK, 2 New Jersey

Transmitting Tubes EXCLUSIVELY Since 1934

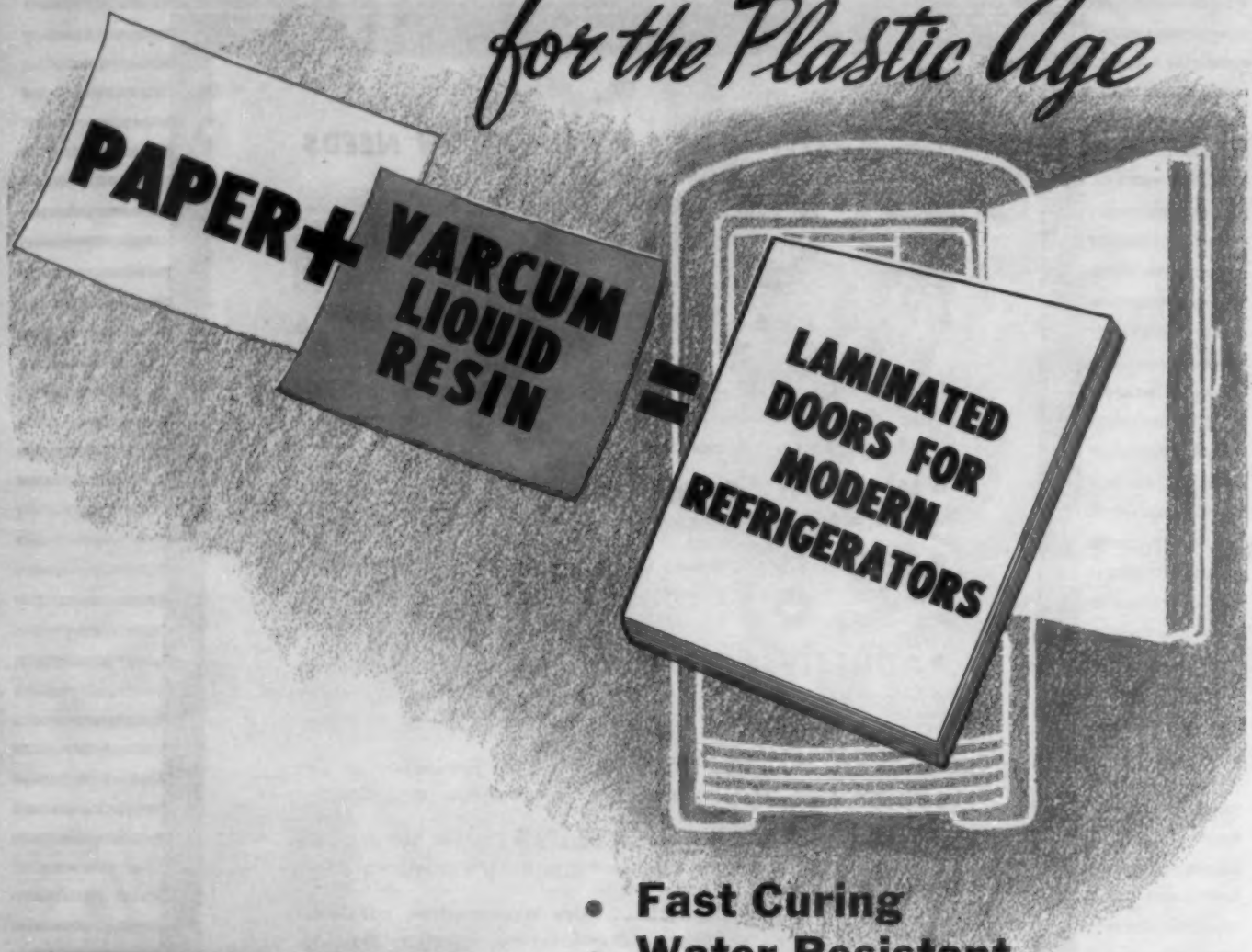
MAKE HOW TO ~~PLAY~~ AN ALL-PLASTIC HARMONICA



1—You design two dies: one to integrally mold the reeds and reed plates, and one to mold the comb and covers (five parts in all). **2**—You select polystyrene because it is moisture-proof and non-corrosive. **3**—You fuss over the varying thicknesses of the reeds (.015" for the low tones) and fret over the clearances (.002"), but since the final plastic result means truer tone and more resiliency, you sweat it through to success. **4**—You cement the five finished parts together . . . play a spirited "Yankee Doodle"—and proceed to tell Japan and Germany what they can do with their brass predecessors. Over 200 operations were eliminated in developing this all-American, all-plastic harmonica. Would you like the details? Inquiries invited!

STERLING PLASTICS CO.
1140 COMMERCE AVENUE, UNION, N.J.

ANOTHER VARCUM DEVELOPMENT *for the Plastic Age*



- **Fast Curing**
- **Water Resistant**
- **Insulating**
- **Light in Weight**
- **No Fire Hazard**

PHOTO SHOWS APPLICATION OF COATING WITH SPECIAL VARCUM RESINS

Based upon developmental work started before the war, special Varcum Liquid Resins for coating paper are today available for the molding of laminated products, for instance the molding of refrigerator door linings.

These linings are highly resistant to moisture and odorless. They are light in weight and provide excellent insulating values.

Varcum Liquid Resins for this purpose are specially formulated to give fast curing. A flat section $\frac{1}{16}$" thickness can be molded in *less than 1 minute!* What's more, since no solvents are required, both the fire hazard and the cost of volatile solvents are eliminated.

For production speed, for quality, economy and safety, investigate Varcum Liquid Resins for paper coating applications. Your inquiry will receive prompt attention.

★ ★ ★ *Synthetic* **VARCUM** *Resins* ★ ★ ★

VARCUM CHEMICAL Corporation

NIAGARA FALLS, N. Y.

NIXON C/N CELLULOSE NITRATE

EASY TO FABRICATE

NIXON C/N is easy to fabricate. It lends itself readily to shaping, drawing, cementing, turning, grinding, machining, embossing, etc. It is dimensionally stable . . . resilient . . . tough. NIXON C/N resists the destructive effects of water . . . alkalies and weak acids . . . and corrosive inks. Ideal for fountain pens and pencils, tool and brush handles, aircraft windshields, spectacle frames, instrument keys, toilet seats, toys, etc. Available in all colors . . . in Sheets, Rods, and Tubes.

NIXON NITRATION WORKS • NIXON • NEW JERSEY

NIXON PLASTICS

NORTHWEST PLASTICS INDUSTRIES • 921 Terminal Sales Building, Portland Oregon • 415 Fourth Cherry Building, Seattle, Washington
HOBBS GLASS, LTD., *Canadian Distributors* — Quebec • Montreal • Ottawa • Toronto • Hamilton • Brantford • London • Windsor • Winnipeg Moose Jaw • Saskatoon • Vancouver • Victoria

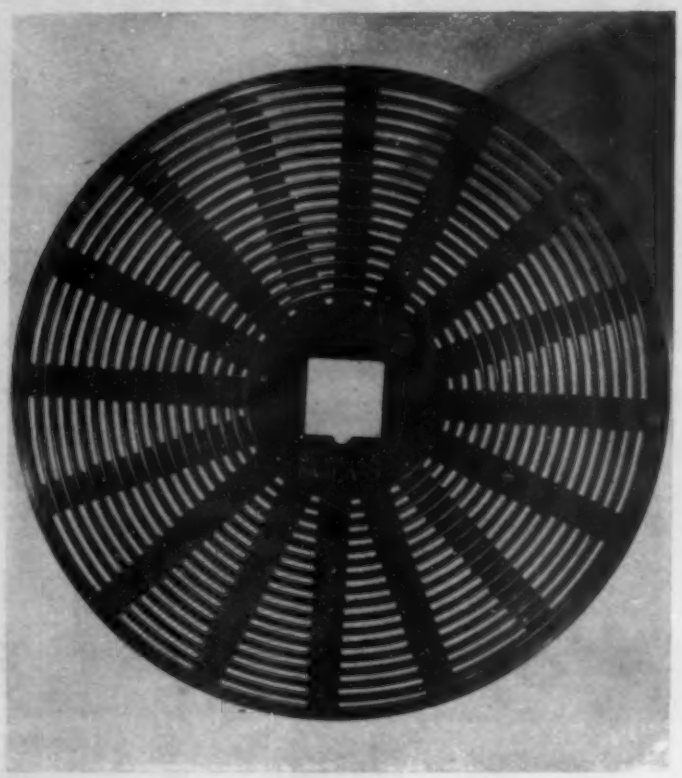
Shortages in critical materials?

Use MAKALOT K.E.M.

Makalot developed K.E.M. to keep our customers molding even under priorities and allocation restrictions. On the left is pictured one of the Toilet Ball floats molded of Makalot K.E.M. Here is a typical example of how K.E.M. molding compounds helped in the continued production of essential civilian products. This valve float ball molded of K.E.M. by Taylor Manufacturing Co. of Milwaukee relieves demands on the critical Phenol and Formaldehyde chemicals, as well as the previously used material, brass. Cafeteria Trays, the beautiful Chesterfield Display Trays, Thermos bottle tops, bottle and jar closures, stove handles, knobs, cup holders, etc., are but a few of the articles molded of MAKALOT K.E.M. The demand for this material is so great we can not promise to fill all orders—but we'll do the best we can. Remember MAKALOT—The Independent Producer of Superior Plastics.

MAKALOT

Thermosetting War Compounds



The Tech-Art Plastics Corp. of Long Island City, New York, well-known for their skill in both design and molding of intricate Plastic products, selected MAKALOT Phenolic Impact material #1804 for the Aeroflex Reel featured on the right. Note the free flowing, the accurate dimensional tolerances and the fine finish. Other outstanding MAKALOT Phenolics are:

Makalot #93-C—CFI-10; Fabric filled super-impact.
Makalot #1040—MFE. The #1 Low Loss material with superior molding characteristics.
Makalot #1163—CFG. General Purpose — unsurpassed in molding and final quality.
Makalot #1912—Exceptionally long flow for transfer.
Makalot #1941—Non-bleeding closure material, with Brilliant finish, fast cure, improved stripping and unscrewing properties.
Makalot #7580—Underwriter's Heater plug material. Excellent flow.
Makalot #2962—Supreme for the past 7 years for satisfactory mold shrinkage. NEVER CRACKS around inserts. Supplied for Compression, Transfer and Jet Molding.
Makalot #1155—Used on the Bomb Boosters—general purpose—fast cure.

Domestic Representatives

CENTRAL STATES
C. R. Olson
1020 15th St.
Rockford, Illinois

PACIFIC COAST
Milton Turk
1425 S. Flower St.
Los Angeles, California

PACIFIC NORTHWEST
Northwest Plastics Industries
415 4th and Cherry Bldg.
Seattle 4, Washington

921 Terminal Sales Building
Portland, Oregon

FABRIC & PAPER IMPREGNATING RESINS · MOLDING COMPOUNDS · UREA RESINS & ADHESIVES · PHENOLIC LACQUERS · VARNISHES

"KEEP 'EM MOLDING"

Makalot

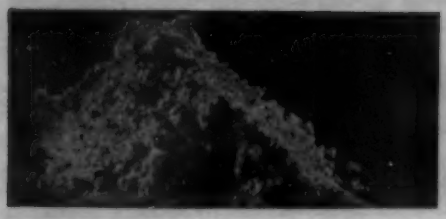
CORPORATION

PLASTICS

262 Washington St., Boston, Mass.

The Independent Producer of Superior Plastics

In designing modern plastic items have a working knowledge of Fillers



FILFLOC Pure cotton flock of surpassing cleanliness and uniformity.

FABRIFIL Macerated cotton fabric for extra strength.

CORDFIL Evenly cut lengths of tire cord; for plastics of utmost strength.

It is not overstating to say that recent progress in fillers has permitted plastics performance not otherwise possible.

With a good working knowledge of fillers, the designer has the right start. He can visualize in terms of the possibilities of the three basic types of Rayco Fillers: "Filfloc", "Fabrifil" and "Cordfil", and can balance performance requirements and cost limitations.

We offer wholehearted assistance in your study of fillers—at any stage, whether design, compounding, or molding. The ability of fillers to impart impact, tensile and flexural strength is tremendously versatile, and we furnish innumerable varieties of our three basic types, in order to suit each need EXACTLY. We invite you to make fullest use of our experimental and research resources, as well as our exceptionally fine manufacturing facilities.

UTILIZE PLASTIC HELMET LINER SCRAP

Molders are continually finding new applications for this low-priced molding compound of the phenol formaldehyde type. We have a considerable supply available. Prices promptly quoted.

RAYON PROCESSING CO. of R.I. INC.

60 TREMONT ST., CENTRAL FALLS, RHODE ISLAND

Developers and Producers of Cotton Fillers for Plastics

OBTAIN COMPOUNDS CONTAINING RAYCO FILLERS — FOR GOOD FLOW AND EXTRA STRENGTH

Consultation with members of our Planning Division involves no obligation on your part . . . if you are considering the use of molded plastics parts in your production or planning to merchandise a plastics product.

Universal offers a custom molding service embracing every phase from consultation to delivery of the finished part or product.

We invite inquiries from manufacturers who believe we can be of help.

UNIVERSAL
PLASTICS CORPORATION

NEW BRUNSWICK · NEW JERSEY

Additional Plants at FORDS, N. J. and DUNNELLEN, N. J.

Main Office: Empire State Building, New York 1, New York • Steel Mill Products Company, Inc., 176 West Adams Street, Chicago 3, Illinois
Paragon Sales Company, Inc., 111 South Street, Philadelphia, Pennsylvania • June & Company, 719 New Center Building, Detroit 1, Michigan

OVER THE HUMP and ONWARD with DoALL Zephyr

Here's the fastest DoALL—the advance model that is doing a sensational job of cutting plastics, plywoods, laminates and non-ferrous metals in the aircraft industry—keeping ahead of delivery schedules.

Developed especially to handle the new war-born materials that will play an important part in all kinds of products of the future.

A FEW *Zephyr* SPEEDS

1/8" **Methyl Methacrylate**	**135 lin. in. per min.**
1/4" **Molded Phenolic**	**200 lin. in. per min.**
1/16" **Laminated Phenolic**	**230 lin. in. per min.**
6" **Polystyrene**	**40 sq. in. per min.**

Except at point of work, all moving parts are fully housed, giving utmost protection to operator who has fingertip control for instant stopping, starting and changing speeds. Weighs 3,300 pounds—a pillar of ruggedness to eliminate vibration and support speeds up to and including 12,000 f.p.m.

For now and the future—investigate the DoALL Zephyr. Write for literature.

DoALL

INDUSTRY'S NEW SET OF TOOLS

CONTINENTAL MACHINES, INC.
1330 S. Washington Ave., Minneapolis 4, Minn.

Sales & Service Offices: Baltimore, Birmingham, Boston, Chicago, Cincinnati, Cleveland, Denver, Detroit, Erie, Grand Rapids, Hartford, Houston, Indianapolis, Los Angeles, Milwaukee, Minneapolis, New York, Orlando, Philadelphia, Pittsburgh, Providence, Rochester, Rockford, St. Louis, San Francisco, Seattle, Toledo, Tulsa.

All classified advertising payable in advance of publication. Minimum, $5.00 (up to 60 words); in border, $10.00 per inch.

Classified Advertisements

For further information address Classified Advertising Dept. MODERN PLASTICS 122 East 42nd St., New York 17, N. Y.

MIDWESTERN REPRESENTATION

Young, aggressive midwestern firm headed by outstanding salesman of many years experience, wishes to aggressively represent reliable firms in this area. We cover wholesale or retail outlets and guarantee results. Line up now for market control at lower sales costs.

G. D. Nichols, President
INDUSTRIAL PLASTICS CORPORATION
161 W. Wisconsin Ave. DAly 3665
Milwaukee 3, Wisconsin

SALESMEN—With established industrial contacts, now representing injection or compression moulders, desirous of rounding out their line and service. Large eastern extrusion organization, engaged in war work, wants representation in cities east of Chicago. Splendid opportunity for substantial earnings on commission basis. Every cooperation. Write in detail to Box 1108, Modern Plastics.

WANTED: THERMOPLASTIC SCRAP or rejects in any form, including Acetate, Butyrate, Styrene, Acrylic and Vinyl Resin materials. Submit samples and details of quantities, grades and color for our quotations. Reply Box 508, Modern Plastics.

FOR SALE: 1—500 ton Hydraulic Press with downward moving ram and pushbacks. Box 512, Modern Plastics.

Arthur Swanson & Associates

PRODUCT DESIGN

Executing designs for post-war manufacturing

540 N. Michigan Ave., Chicago 11, Ill.

FOR SALE—1 Worthington Hyd. Pump 1 x 6, 5 GPM 6000 pressure M.D. 1 Hyd. Press 24" x 24", 14" ram; 1 Set 15" x 40" compounding rolls. 15" x 18" Hyd. Press, 10" ram; 1—14" x 24" Press, 9" ram; 4—24" x 55" steel cord Heating Platens; 4—W. & P. Mixers; 4—Semi-Automatic 100-ton Hydr. Presses, platen area 20" x 36"; Allen 6" Tuber; Dry Powder Mixers; Pulverizers, Grinders, etc. Send for complete list. Reply Box 447, Modern Plastics.

PLASTICS DEVELOPMENT LABORATORY. We are unusually well equipped with trained personnel and adequate chemical and physical apparatus to conduct your long range developments as well as many of your plant control problems. [illegible]astics since 1916. HAROLD A. LEVEY [illegible]ATORIES, New Orleans 18, Louisiana.

WANTED: Small or medium sized plastic molding plant with either hydraulic extrusion or injection equipment with or without tool shop. Advise full details. Reply Box 788, Modern Plastics.

WANTED: Small or medium size plastic injection molding plant, with or without tool shop. Advise full details. Detroit Production Company, 910 Majestic Bldg., Detroit 26, Michigan.

IN THE MARKET FOR: Stainless Steel or Nickel Kettles, Vacuum Pan, Preform Machine and Mixer, Hydraulic Presses. Reply Box 825, Modern Plastics.

SPENCE & RIGOLO

PRODUCT DESIGN & ENGINEERING
MARKET RESEARCH

677 Fifth Ave., New York 22, N. Y.

WANTED—Large middlewest tank manufacturer is seeking a man experienced in plastics, enameling, and other coatings with knowledge of modern production methods. Advise age, experience and by whom now or formerly employed. A splendid opportunity for the man who can qualify. Address Box 1163, Modern Plastics.

POST-WAR PLANNING—Manufacturers requiring representation in England and Continent—are invited to write "The Advertiser" who has had a wide experience in the automobile, aircraft, armament and radio industries as tool and production engineer. Contracts manufactured if necessary. 59 Bamford Rd., Didsbury, Manchester, England.

CANADA, A Large Post War Market—Wide-awake, reliable Canadian sales organization, having connections with wholesale hardware, chain and department store trade, can accept representation for additional factory requiring Canadian factory agents operating on commission basis, providing line does not conflict with present representations. H. HACKING CO. LTD., 144 Water Street, Vancouver, Canada (Est. 1916). Canadian Branches from Coast to Coast.

PRODUCTS WANTED for Hotels, Restaurants and Institutions, now and postwar, by New England distributor. Box 1164, Modern Plastics.

SOUTH AFRICA

Progressive Manufacturers' Representatives wish to establish immediate contact with Manufacturers of Plastic Products of all descriptions including Engineering and Household Requisites and Novelties with a view to appointment as sole South African Representatives. Replies to: The Advertiser, P. O. Box 2533, Johannesburg, South Africa.

MOLDER'S
SALES REPRESENTATIVES

Young, aggressive firm, situated in N. Y. C. seeks to represent injection, compression molder. Experienced in all phases of plastics engineering, sales, and service. Reply to Box 1165, Modern Plastics.

YOUNG PLASTIC ENGINEER desires part-time by mail designing dies, jigs, and fixtures for compression, transfer, or injection molding. Is graduate of Plastic Industries Technical Institute and is now engaged over year and one-half with well known plastic manufacturer. Write or wire to G. W. Lewton, R. D. 1, Elyria, O.

WANTED: Cellulose Nitrate sheets or strips of .060 to .070 thickness, suitable for stamping blanks from ⅜ inch, to 3 inch diameter. Prefer transparent but can use some laminated in colors. Send samples with quotations to Florida Supply House, 415—12th St., Bradenton, Florida.

PLASTICS ENGINEER-WOOD TECHNOLOGIST desires change. Has wide experience covering many years in research and development on laminates of wood, paper and fabric and their combinations. Understand low-pressure laminating using many resins. Also sales and executive experience. West Coast only. Reply Box 1166, Modern Plastics.

WANTED—Now or postwar Pacific Coast area distribution rights or agency for industrial plastic products. Well established and thoroughly acquainted with all large and small manufacturers from Seattle to Mexico through 25 years selling experience. Sufficiently financed to carry stock. Reply Box 1167, Modern Plastics.

COMPRESSION MOLDING TIME AVAILABLE on presses 200-ton, 24" x 24" Platens and 100-ton 13" x 13" Platens. Can give you prompt delivery on large and small orders. Peters Plastic Molding Co., 33 Melbourne, Detroit 2, Michigan.

WANTED—MOLD DESIGNER. Injection molding plastics concern in Detroit, Michigan, area desires services of experienced designer. Unlimited opportunities for advancement in rapidly expanding plastics division. State experience and salary requirements in reply. Box 1168, Modern Plastics.

MANUFACTURERS NOTICE—Our sales organization has a five year record of success specializing in the sale of plastic products in midwestern and southern states. We sell to jobbers and direct to department stores, drug stores, hardware stores, men's stores and gift shops. Now open for an additional good plastic line. Reply Box 1169, Modern Plastics.

FOR SALE: W. & P. 100 gal. Jacketed Mixer; W. & P. 150 gal. Stainless Steel Lined Mixer; W. & P. and Day 9 to 40 gal. Heavy Duty Mixers; Colton, Stokes Rotary Tablet Machines; Colton, Mulford Single Punch Tablet Machines, up to 1½"; Farrel Birmingham 15" x 36" Mixing Mill; Pulverizers; Grinders; Kettles; etc. Your inquiries solicited. We buy your surplus equipment. BRILL EQUIPMENT COMPANY, 225 W. 34th St., New York 1, N. Y.

VETERAN seeks job in plastics—fabrication experience in furniture, and cosmetic field. Reply Box 1170, Modern Plastics.

MANUFACTURERS AGENTS WANTED
FOR FABRICATED PLASTIC PARTS LINE

A splendid commission opportunity is offered aggressive agents or sales engineers with connections and experience selling parts or assemblies to manufacturers of automotive, aviation, electrical or related devices. Line includes fabricated plastic parts, assemblies and products, which can be handled with other non-competitive items for same trades. Compensation plan consistent with qualifications, ability and territory. Protected territory now being assigned. Phone, wire or write

MC INERNEY PLASTICS COMPANY
Phone 6-1481 675 Godfrey Avenue, S.W.
Grand Rapids, Michigan

FOREMAN—Knowledge and experience of fabrication—Lucite—Plexiglas, desires to locate with a going concern anywhere. Box 1173, Modern Plastics.

PRODUCT DESIGN ENGINEER

Graduate architect or industrial design engineer, under 35 years of age, to initiate and develop new consumer product designs in glass. Should have manufacturing experience and ability to coordinate his work with Sales, Production and Research departments. Here is a real opportunity to join America's leading glass manufacturing company. This is a new position, with excellent prospects for the man willing and able to do creative work. If not now engaged in essential war work, write Personnel Department, giving complete description of education, professional experience, draft status. Enclose recent photograph. Salary commensurate with abilities. All replies confidential.

CORNING GLASS WORKS
Corning, New York

WANTED: Plexiglas and Lucite scrap in large quantities. D. L. Lukens, 109 North Street, Harrisburg, Pa.

MODEL MAKER WANTED

We are looking for a man, experienced in making plastic and metal models. These models are made prior to production of injection-molded and metal-stamped parts which are partly ornamental and partly of a utility character. This is a good opportunity for a capable man looking for a steady postwar job. We are an old-established concern. Write in detail to Box 1174, Modern Plastics.

IMMEDIATE DELIVERY

New molding and laminating Hydraulic Laboratory Press. 12-ton capacity, 8 x 8 platens, 7 in. stroke, 16 in. maximum daylight, complete with thermostatically controlled electric calrod heating plates and pressure gage. $210 F.O.B. Cleveland, Ohio.
Write for illustrated details.
Box 1172, Modern Plastics.

TEXTILE COATINGS CHEMIST by large Eastern manufacturer of lacquer, vinyl, alkyd and other synthetic resin coatings. Excellent opportunity for man with textile coatings experience. Salary commensurate with ability. Give full qualifications and detailed information in first letter. Will be held in strict confidence. Write Box 1176, Modern Plastics.

FOR SALE: Watson-Stillman 225 ton Transfer Molding Press; 12—Molding Presses 50 to 150 tons; Farrel-Birmingham 36" x 36", 12" Ram; Adamson 30" x 40", 12" Ram; Morane 30" x 36", 10" Ram; Birm. 24" x 24", 9" Ram; Watson-Stillman 24" x 36", 6" Ram; 22" x 24", 5½" Ram; 25" x 36", two 5" Rams; 48" x 26", four 3½" Rams; 78" x 36", two 7½" Rams; 40 ton Downstroke Broaching Press; 400 Ton Hydr. Extrusion Press; Others up to 1600 ton; H.P.M. Vert. 2 plgr., High & Low Pressure Hydr. Pump; W. S. 1¼" x 12" Horiz. 4 plgr., 30 GPM, 3500 lbs.; Wat.-Farrel 1¼" x 4", Vert. Triplex, 6 GPM, 3000 lbs.; Goulds 2¼" x 8" vert. Triplex 30 GPM, 1600 lbs.; Elmes 1¼" x 4" Horiz. 4 plgr., 8½ GPM, 3600 lbs.; 1" x 4" & 1⅛" x 4" Horiz. 4 plgr., 5 to 6½ GPM, 4500 lbs. & 5000 lbs.; Rumsey 4½" x 8", Vert. Triplex, 65 GPM, 900 lbs.; 2—10 HP Horiz. 1¼" x 4" Triplex, 6 GPM, 3000 lbs.; National ¼" x 3" Horiz. Triplex, 2 GPM, 3000 lbs.; Hele-Shaw Oil Pump, 25 GPM, 1200 lbs.; Hydr. Steam Pumps up to 150 GPM; Low Pressure Pumps from 150 to 600 lbs.; Hydr. Accumulators, Tank & Weighted Types; Royle #2 Extruder; ½" & ¾" Preform Tablet Machines. Heavy duty double arm Mixers up to 150 gals.; Ball & Jewell Rotary Cutters; Grinders, Pulverizers; Gas Boilers, etc. ONLY PARTIAL LISTING. SEND US YOUR INQUIRIES. WE ALSO BUY YOUR USED MACHINERY. STEIN EQUIPMENT CO., 426 BROOME ST., NEW YORK 13, N. Y. CANAL 6-8147.

WANTED

Acrylic Manufacturing Company to supply us with Resin for permanent reliner for dental plates for resale to dental profession.

Genesee Bailey Drug Co., Inc.
Buffalo 11, N. Y.

WANTED—Experienced man to supervise small plastic plant. Must know compression molding, production, etc. Wonderful future. Excellent pay to start. Plant located in Detroit. Reply Box 1177, Modern Plastics.

FOR SALE: Plastic Sheeting Plant. Complete plant equipment for the production of transparent packaging sheeting from cellulose derivatives and resins in thicknesses .0005" to .003" x 48" wide, continuous process. Will move same and re-erect on your site. Patents, formulations, "know how," and your technical staff trained in these operations for the sale price. Reply Box 1178, Modern Plastics.

WANTED
Extrusion Technician
Extrusion Machine Takeoff Mechanism

Important company setting up extrusion department on experimental basis, planning toward postwar production—requires services of experienced extrusion technician with knowledge of plastics. Also, extrusion machine desired for purchase—either experimental or production size. All correspondence confidential. Box 1175, Modern Plastics.

WANTED—Draftsman for mechanical engineering work in plastics industry plant located near Boston, Massachusetts. Permanent position. Special experience in plastics not necessary. However, experience with hydraulic equipment, or tool and die work, desirable. Submit full details. Reply Box 1179, Modern Plastics.

WANTED—by Automotive and Hardware Manufacturer, ALLIED ITEMS, staple or novelty, in plastic, metal or wood, either parts or complete, for manufacturing and/or assembling in our plant. National and foreign outlets. Reply Box 1171, Modern Plastics.

PLASTIC ENGINEER to take complete charge of plant. To one thoroughly experienced an unusual opportunity. Applications will be considered strictly confidential. Address

P. O. Box 54, Station P, New York City.

WANTED: PLASTIC SCRAP OR REJECTS in any form. Cellulose Acetate, Butyrate, Polystyrene, Acrylic, Vinyl Resin, etc. Also wanted surplus lots of phenolic and urea molding materials. Custom grinding and magnetizing. Reply Box 318, Modern Plastics.

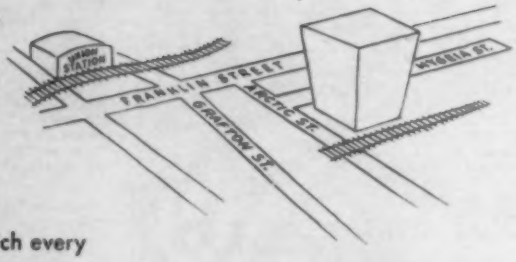
INDEX TO ADVERTISEMENTS

MODERN PLASTICS*
PLASTICS*
PLASTICS ENGINEERING*
PLASTICS PRODUCTS*
*REG. U.S. PATENT OFFICE

MODERN PLASTICS
Published by MODERN PLASTICS, INC
122 EAST 42nd ST., NEW YORK 17, N. Y.

Announcement

We are not going far, only two blocks, but we are going to increase the size of our facilities shortly, by moving into and occupying an entire five story building. These added facilities will broaden every phase of our thermoplastic moulding techniques — with new machines of our own construction which will possess injection moulding capabilities never before equalled, plus die design, die making, and finishing. And we will carry over the one thing which every prospective customer has come to appreciate — an ability to help answer your first question about the use of plastics.



For Custom Injection Moulding . . . try the Trio

8 GRAFTON STREET WORCESTER 8, MASSACHUSETTS
17 EAST 42nd ST., NEW YORK 17, N. Y.

BAKELITE

TRADE-MARK

Ideas are Ammunition, Too

This is the largest item ever molded from BAKELITE phenolic molding board, BM-9725. It's an ammunition box for a bomber belly turret that packs looped lightning in the form of long belts of cartridges. It is 25½ in. by 17½ in. by 6½ in. in size. It is extremely lightweight, highly resistant to impact, abrasion, moisture, and chemicals, and has high tensile strength.

Until now, the plastics industry has used BAKELITE phenolic molding board chiefly for much smaller parts. The idea of employing its outstanding advantages for a large scale molding job was revolutionary, but has more than justified itself in a product that stands strenuous service, and is economically produced. Rigidity and extra strength are attained by molding the box from two sheets of BM-9725 around a sisal core that has been impregnated with phenolic resin. Both halves of the box are formed simultaneously in one cast iron mold. The press is equipped with banks of infrared lamps for preheating the mold charge and operates at a pressure of 4,000 pounds per square inch.

Ideas such as those that produced this box are ammunition for present and future planning—ammunition that hits the mark in product improvement and production economy. BAKELITE molding boards are available in sheets, blanks, and as diced material. They can be molded on existing equipment—either alone, or in combination with other BAKELITE plastics to reinforce vital points. Write Department 15 for full information and suggestions regarding molding techniques

TRADE MARK

BAKELITE CORPORATION, 30 E. 42 St., New York 17, N. Y.

Unit of Union Carbide and Carbon Corporation

UCC

Molding Plastics

SUCCESSFUL DESIGN FOR PLASTICS DEPENDS UPON THE CORRECT APPLICATION OF SOUND DESIGN PRINCIPLES. A NEW TWENTY-FOUR PAGE DESIGN BULLETIN HAS BEEN PREPARED BY THE PLASTICS DIVISIONS OF THE GENERAL ELECTRIC COMPANY AND INCLUDES A LISTING OF MATERIALS, DESIGN CONSIDERATIONS AND MOLDING PROCESSES. FOR YOUR COPY WRITE TODAY TO SECTION A-1, ONE PLASTICS AVENUE, PITTSFIELD, MASS.

Hear the General Electric radio programs: "The G-E All Girl Orchestra" Sunday 10 P.M. EWT, NBC. "The World Today" news every weekday 6:45 P.M. EWT, CBS.

Buy War Bonds

CALL A G-E PLASTICS TECHNICIAN FOR SOUND ADVICE

GENERAL ELECTRIC

PD-1